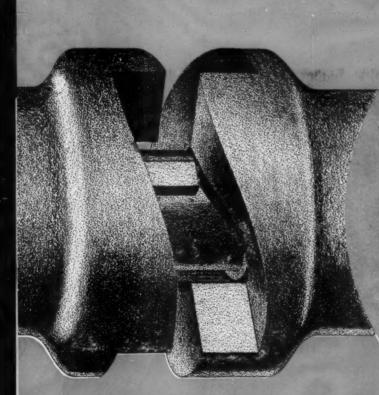
POWER **JULY 1960** TRANSMISSION DESIGN MACHINE DRIVES & COMPONENTS



ALSO IN THIS ISSUE: One shaft drives 78 gears New ball standards





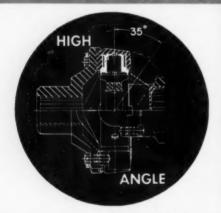
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ture cannot enter. If you have a "tough" joint problem and need the "right" solution, it will pay you to make use of MECHANICS engineers' wide experience in solving power transmission problems in hundreds of different fields.

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ADVANTAGES OF FLEXIBLE SHAFTING

For Power Drive and Remote Control

by
C. Hotchkiss, Jr.
Application Engineer
Stow Manufacturing Company

Flexible shafting has the following advantages over the other type drives:

- 1—it is often the simplest method of transmitting power between two points which are not collinear or which have relative-motion.
- 2—eliminates exposed revolving parts
- 3—does not require accurate alignment
- 4-easy to install and maintain

Not Collinear.—Where it is necessary to connect two shafts which are not collinear, a simple arrangement of a single belt or two universal joints will often do the job adequately. But, in many cases where the path of transmission is more complicated and would require a more expensive arrangement of mechanical components, flexible shafting provides a simple, low cost, efficient drive which is easy to install because it does not require accurate alignment. See example, figure 1, in which a 1½-inch Stow flexible shaft is used to drive the auger on a G.L.F. bulk feed truck.

Flexible shafting also allows the designer greater freedom in locating either the drive or the driven component on a piece of equipment.



Fig. 1



Relative Motion — Where two shafts which have relative motion must be connected, flexible shafting is often the ideal means of transmission. In many cases it eliminates a much more complicated drive which would, necessarily, include telescopic joints; further, it eliminates the danger of exposed moving parts. See figure 2, which shows a %-inch Stow flexible shaft driving an Avery Rake built by the Minneapolis Moline Co.



Fig. 2

Other typical applications of this type are used on portable power tools when motors are too heavy to be mounted on the tool—such as portable grinders, sanders, paint scrapers, saws and tree tappers. And, since flexible shafting is not affected by vibration, it is an ideal drive for applications where a high degree of vibration is involved—such as in vibration testing tables and concrete vibrators.

Stow flexible shafts are available: for power drive applications in diameter sizes from ½-inch to 1¼-inches; for remote control applications in diameter sizes from ½-inch to 15%-inches. The 1¼-inch power drive shaft will transmit up to 10 HP while the 15%-inch remote control shaft will transmit up to 4000 lb. in.

For complete engineering data on flexible shafting, including selection charts, write for engineering bulletin 570.

STOW MANUFACTURING COMPANY

440 SHEAR STREET

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because each belt does more



Leave it to Goodyear—pioneer of the original "wedge" design. By stripping away excess bulk by dimensionally stabilizing via Goodyear's exclusive 3-T processed cord and by building in oil-resistant and static-conducting features (at no extra cost) they give you completely matched sets of super V-belts. With these HY-T WEDGE V-Belts you handle substantially greater horsepower—on more compact drives—over a longer, more trouble-free service life.

For the full story on HY-T WEDGE V-Belts or any other belt in the complete Goodyear line, contact the G.T.M.—Goodyear Technical Man—through your Goodyear Distributor. Or by writing Goodyear, Industrial Products Division, Lincoln 2, Nebraska, or Akron 16, Ohio.

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THE GREATEST NAME IN RUBBER

JULY 1960

volume 2 number 7

FEATURE

POWER TRANSMISSION DESIGN

1

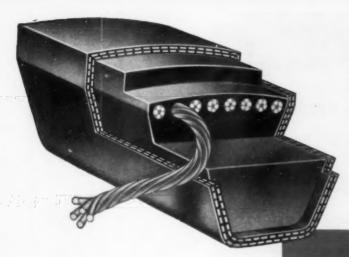
POSITIVE-CONTACT CLUTCHES AND BRAKES

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DA POSITIVE DRIVE BELTS. Revolutionary tooth-grip principle; no stretch; no constant lubrication. Highly versatile.

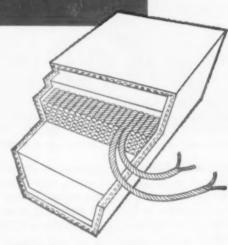
Whatever your V-Belt needs, DURKEE-ATWOOD meets them

What do you want in a V-Belt? You want consistent performance, long trouble-free life and full-rated power transmission. That means the belts must be made of the finest quality materials, with careful attention to engineering details, manufacturing processes and testing procedures. Durkee-Atwood V-Belts are made of the newest high tenacity synthetic fibres to assure length stability in storage. The exclusive Durkee-Atwood "Iso-Dynamic" Vertical Matching Machine eliminates the "sag error" that develops when V-Belts are matched on horizontal equipment. This assures equal power transmission from all belts on multiple drives . . . Look to Durkee-Atwood for quality, service and savings ... the most complete line of industrial V-Belts.





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40% Extra Capacity in Regular V-Belts?

RED SHIELD MULTIPLE V-BELTS. Increased capacity at no increased cost. Available in oil and heat resistant and static dissipating constructions.



Top Performance in Variable Speed Drives?

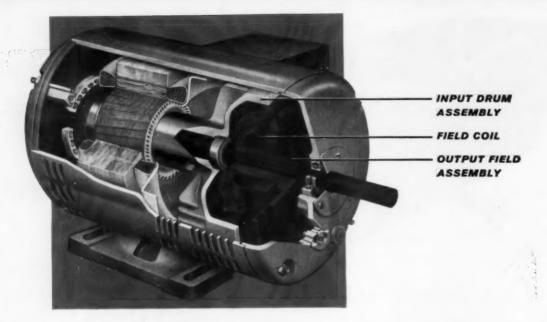
VARIABLE SPEED BELTS. For constant performance. Abrasion-resistant cover; crowned cross section maintains stability under extreme loads.

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Wherever infinite adjustment and accurate control of speeds are required, Eaton-Dynamatic Ajusto-Spede Drives offer a simple, low-cost solution to the problem—stepless adjustment from zero to full output speed, and accurate control of any speed within the speed range.

The Dynamatic Ajusto-Spede Drive is an integral combination of AC constant speed induction motor, eddy-current coupling, and plug-in type single-tube electronic control. Torque developed in the motor is transmitted to the driven member by electro-magnetic attraction; there is no mechanical contact between the driving and driven members.

Dynamatic Ajusto-Spede Drives operate on standard 115/230 volt, single phase, 60 cycle or 220/440 volt, 3 phase, 60 cycle alternating current—no special power source is required. Sizes are ½, ½, and ¾ horsepower at 1600 RPM; ½, ¾, and 1 horsepower at 3200 RPM.

With standard, special, or remotely mounted transistorized control, Dynamatic Ajusto-Spede Drives offer many worthwhile advantages not found in other methods of speed control. Send for illustrated descriptive literature.



DYNAMATIC AJUSTO-SPEDE DRIVE WITH ELECTRI-CALLY OPERATED BRAKE. With the safety type friction brake, it is possible to achieve rapid deceleration and quick stop, thus providing fast cycling operation.



DYNAMATIC AJUSTO-SPEDE DRIVE WITH INTEGRAL SPEED REDUCER. Because of the variety of gear ratios available in the reducer, this compact assembly is adaptable to a wide range of slow speed applications.

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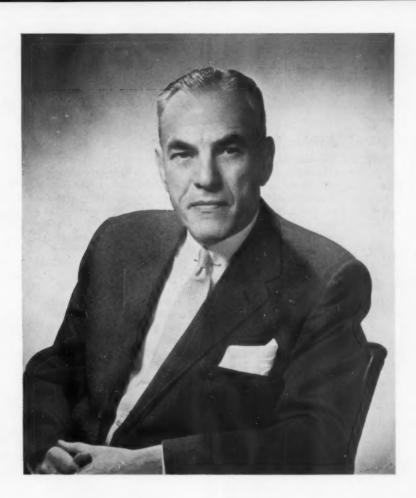
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ORIGINATORS OF EDDY-CURRENT SPEED CONTROL EQUIPMENT

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POWER TRANSMISSION DESIGN



IRVING B. HEXTER 1897-1960 Founder, The Industrial Publishing Corporation

ONCE YOU MET Irving Hexter, you remembered him. He didn't leave neutral impressions. He probably was never neutral about anything in his life. He reacted strongly to things, responded warmly to people—and they to him. He devoted nearly as much effort to people as he did to the publishing firm he founded. Scores of worthy causes asked his help. None was ever refused. His great labor of love was the American Heart Association. He served it as a national officer for years, was the third layman ever to win its Gold Heart Award. He established and endowed a laboratory for heart disease research.

Spending time with Irving Hexter was exhilarating. He had energy enough for five men and it was infectious. He generated ideas at a furious pace; his energy sparked the men around him. You worked a bit harder than your best for him, not because he drove you, but because you couldn't do less and face him. He could spot a phony or stuffed shirt a mile away. He abhorred them.

Irving Hexter traveled 35 weeks a year, with Mrs. Hexter had seen nearly every part of the globe. Living out of a suitcase was his kind of relaxation. He could out-work, out-travel, out-enjoy-living any man in the company. With fierce energy he started a little magazine at the bottom of the depression, built it into a major publishing firm. Then, he assured its permanence by divesting himself of ownership and, more recently, day-to-day management. Not that he slowed down. Irving Hexter had only one speed: forward, high. He was researching another new publication idea when his heart failed. He died May 22 at 62, just a few months before the 30th anniversary of the company he founded.

NEWS from the power transmission field

New NEMA division holds first meeting

NEW YORK, N. Y.—The newly-organized Consumer Products Div. of the National Electrical Manufacturers Association held its first annual meeting last month at the Edgewater Beach Hotel, Chicago.

The new division, headed by H. L. Travis of Kelvinator Div., American

Motors Corp., is one of eight formed this year to streamline and strengthen NEMA. These sections held separate meetings: electric ranges, electric water heaters, refrigerators, freezers, dishwashers, room air conditioners, and housewares and elec-

Gear deburring machine handles big jobs

ROCKFORD, ILL.—A machine to deburr and chamfer large spur, helical, worm, and bevel gears, as well as splines, has been developed by Redin Production Machine Co. It will handle external gears up to 36 in. and internal gears to 32 in. pitch diameter. The work spindle has a capacity of more than a ton.

In operation, a floating wheel spindle automatically follows the contour of the tooth. No wheel dressing, change gears, or followers are needed. The photo shows a $34\frac{1}{2}$ in. diameter steel gear, weighing 1250 lb, being loaded on the machine. One side of this gear was deburred in 2 minutes.



AGMA elects officers

Washington, D. C.—The American Gear Manufacturers Association held its 44th annual meeting last month at The Homestead, Hot Springs, Va. These officers were elected: President—James F. Murray, president, Winsmith, Inc.; Vice President, Products Div.—Charles F. Bannan, vice president, Western Gear Corp.; Vice President, Technical Div.—Folke Richardz, consulting specialist, gearing products, Westinghouse Electric Corp.; Treasurer—J. Harper Jackson, sales manager, Jackson Gear Co.

Elected to the board of directors: S. M. Brooks, executive vice president and secretary, Tool Steel Gear & Pinion Co.; W. W. Trout, president and general manager, Lufkin Foundry & Machine Co.; E. V. Rankin, vice president, Boston Gear Works; J. S. Gillespie, general manager, Gear Motor & Transmission Components Dept., General Electric Co.; F. A. Smyth, president and treasurer, Alling-Lander Co., Inc.

E. J. Wellauer, director of research and development, Falk Corp., received AGMA's Edward P. Connell Award. This award is given to an individual who has made outstanding personal contributions to further the art of gearing. Wellauer's award was based largely on his work on gear strength and durability ratings.

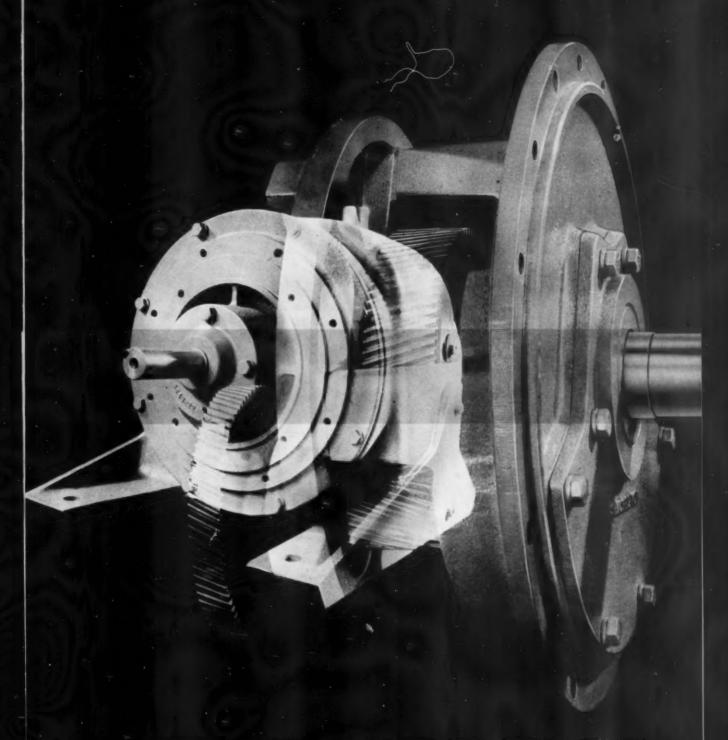
Howell buys Diehl

HOWELL, MICH.—Howell Electric Motors Co. has acquired the entire line of totally-enclosed flat-type motors from Diehl Mfg. Co., a division of Singer Mfg. Co.

Magnetic particle clutch in traveling exhibit

WASHINGTON, D. C.—A coupling using fine iron particles that become a solid bond when magnetized is being shown by Eaton Mfg. Co. in an exhibit sponsored by the Patent Office. The exhibit, which will tour the country, will relate unusual patent stories and the basic concepts of certain inventions.

In Eaton's magnetic particle clutch, there are two cylindrical faces or plates, one rotating inside the other with a narrow air gap between them. When electric current is applied, the

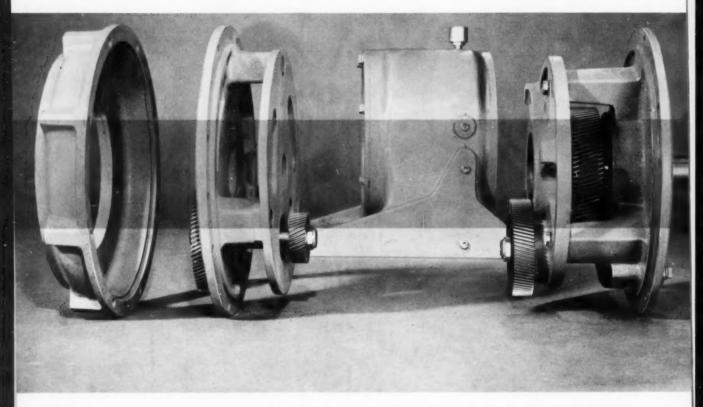


NEW MODULINE GEAR UNITS

OFFER YOU ORIGINAL ADVANTAGES IN SIMPLICITY • VERSATILITY • DEPENDABILITY

MODULINE

IS ORIGINAL IN SIMPLICITY...IN VERSATILITY



Basic Moduline components combine to form double, triple or quadruple reduction speed reducers, gearmotors or package motor reducer drives with gear ratios from 4.17:1 to 985.3:1.

These preassembled modules standardize over 20,000 variations of gearmotors, speed reducers and package motor reducer drives

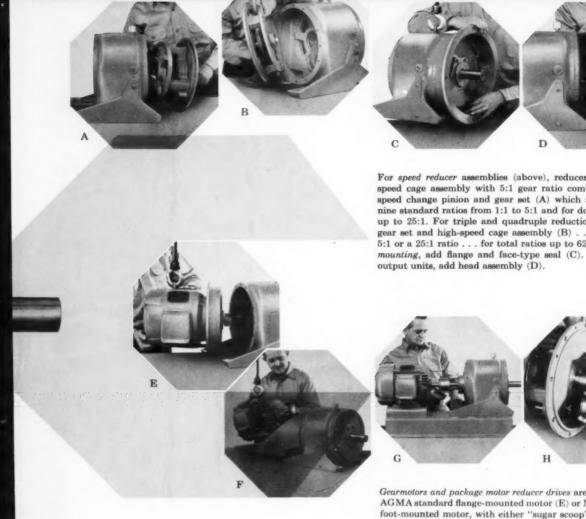
Look over the simplicity, dependability and versatility you get from Westinghouse Moduline gear units. Here you'll find original answers to solve long-standing problems in application of gearmotors and package motor reducer drives from 1 to 30 hp; foot-mounted speed reducers from 1 to 75 hp; and shaft-mounted speed reducers from 1 to 40 hp, including concentric shaft and right angle configurations.

What's more, just seven Moduline frame sizes cover these broad ranges. By ordering Moduline drives, together with any type of Westinghouse Life-Line® motors, you combine two purchases in one order with complete assurance of design and application coordination.

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EXCLUSIVE DEVELOPMENT OF





(F) or combination bedplate (G). Backstop added to any unit.

A standard wrench assembles or modifies any Moduline unit

Only a wrench is needed to work on Moduline units. Awkward gear pullers and troublesome fitting have been eliminated. It's another example of the original advantages you gain from Moduline design and quality.

Unusual manufacturing processes, preassembly and pilot fits make modular construction possible. All parts are accurately machined within very close tolerances. No checking, aligning or positioning of modules is necessary during assembly.

Moduline shafts are roll-formed to provide splined and threaded extensions for simple gear mountings. Pinions and gears have splined bores for ease of assembly. An elastic stop nut locks them in position.

JI-07368-4

WESTINGHOUSE



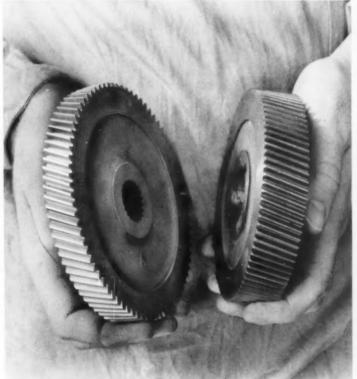
er case and lownine with highare available in ouble reductions ons, add change . . with either a 25:1. For vertical . For right angle



e assembled with NEMA standard o" motor support kit (H) can be

MODULINE

IS ORIGINAL IN DEPENDABILITY



Compare the Moduline ground tooth gear (left) with conventional gear. Note smooth finish, splined bore and drop-forge blank that's standard with all Moduline gears.



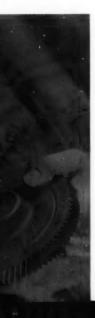
(top) Precision hobbing cuts Moduline gear teeth on alloy steel blanks

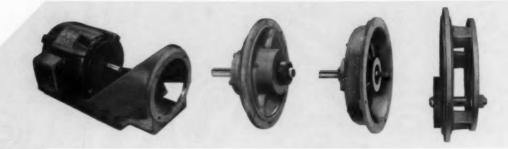
(middle) Through-hardening on automatic spin-flame equipment for extra wear resistance

(lower) Finish grinding to master gear standards

Only MODULINE combines ground "master gear" precision with tough, wear and shock-resistant alloy steels

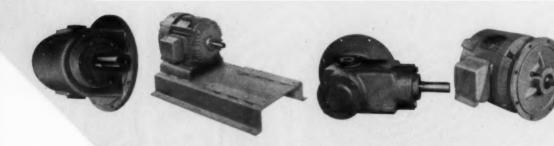
See the difference between a conventional gear and a Moduline precision-ground, heat-treated gear. Moduline gear teeth are so accurate they meet AGMA master gear requirements for pin dimensions, pitch error, profile error and lead error. This means unusual dependability with quiet, efficient operation. Previously, you would have to special-order and pay a premium for the quality now made standard by Moduline. These precision gears have low sound levels and increased mechanical capacity. Spin-flame heat treatment and tempering produce hard, wear-resistant surfaces backed up by tough-hardened cores to stand up under all kinds of service.



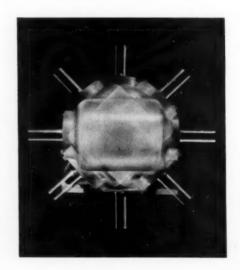


Moduline originality offers application and maintenance savings

Here are subassemblies for the most versatile gear drives on the market. From these modules . . . concentric shaft or right angle . . . integral gearmotors, package motor reducer drives and speed reducers can be assembled exactly to your specifications. Motor support brackets, right angle heads (in fact, all Moduline parts) go together in thousands of different ways to make the right drive for any job.



Moduline units can be installed in any location. Concentric shaft units can be mounted in any position on the floor, wall or ceiling... or at any angle in between. The output shafts of right angle units can be indexed in 8 or 12 positions for power take-off in almost any direction. Units are designed for electric motor or engine drive; chains, belts or gears may be used to put power into or take it out of them. Only Westinghouse offers Moduline units with right angle input or output assemblies. These 1 to 75 hp reducers with ratios from 7.6:1 to 985.3:1 can handle any job.



JI-07368-3

WESTINGHOUSE ELECTRIC CORPORATION

MODULINE

delivery is fast because it's "built in"

Original modular design and complete standardization of components simplifies specification, inventory control and gives fast deliveries from local Westinghouse warehouses.

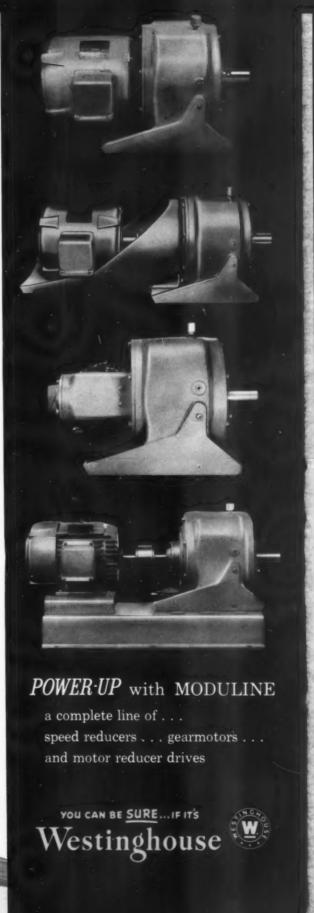
Your local Westinghouse sales office fills your order from a nearby warehouse. Moduline drives are shipped completely assembled to your instructions, ready to go to work. All Moduline warehouses also carry complete stocks of renewal parts and subassemblies for the maintenance or modification of customer units. Fast parts deliveries and serviceability of Moduline designs reduce down time and maintenance costs to a minimum. A small inventory backs up many units for customers who prefer to stock their own parts and subassemblies.

...see MODULINE facts in action

A desk-top demonstration of Moduline scale models is the first step to lower gear drive costs. Your Westinghouse sales representative will arrange a demonstration; or write Westinghouse Electric Corporation, Gearing Division, 200 McCandless Ave., Pittsburgh 1, Pa.

JI-07368-6







ELECTION RT for triple-tested Moline Chains*

Here is a quick, easy reference chart for comparing the seven most popular Moline Chains. Are you familiar with all the attachments available... the range of sizes... and all their applications? This chart will help you compare their size, capacity range and various uses. It's a part of the new, illustrated "Moline Conveyor Chain Manual and Design Engineers' Handbook" which is available now to help you specify the right chain for your requirements.
Write today for your copy.

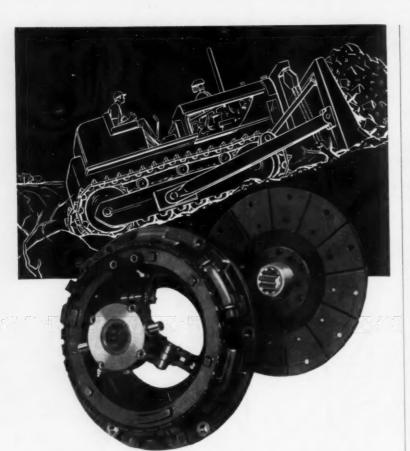
	& NUMBER	APPLICATION AND INSTALLATION	ATTACHMENTS	FITCH RANGE	STRENGTH IN LES
4	Detachable Chains - 25, 32, 33, 34, 42, 45, 50, 51, 5-51, 52, 55, 57, 62, 67, 75, 77, 78, 88, 95, 103, 108, 114, 124	Widely used throughout industry, conform to "manufacturers' standard" and available in a wide variety of sizes. Many attachments make this type versatile and adoptable to any light to medium-duty conveyor service.	A-1-2-3-12-110 C-1-5-8-15 D-3-4-5 E-1 F-2-8-16 K-1-2-3-5-40-73-345 H-1-2 K-1-2-3-5-40 L-2 M-1-3 R-1-2 S-1 Scraper 1-29	.902 to 4.063	700 to 17,000
	Pintle Chains 400 class. Light weight Pintle. 700 class.	Serviceable, long-wearing, moderately- priced chain for general elevating, conveying and power transmission service for drives at low and intermediate speeds with moderate loads. In "400" lightweight and "700" class types.	A·1-12-115 D-5 E-1 F-2-5-16 G-1-6-19 K-1-2 M-1 F-2-5 F-22-6" F-2-22-8" A-2-42 K-1-2-720-A-2-730 720-M-1 M-1-2	1.375 to 4.720	4,200 to 22,000
	H-Type Mill H-60, H-62, H-74, H-75, H-78, H-82, H-85, H-87, H-95, H-124	Designed primarily for heavy drives and transfer conveyors in saw mills and pulp and paper mills but widely used throughout industry. Strong and rugged, provided with wearing shoes for stiffness and long service life.	A-1-12 F-4 G-1-6-19-48 H-1-2 K-1-2 M-3 R&L RR	1.654 to 4.000	7,000 to 30,000
	Combination Type Mill Chain 6104, 6110, 8116, 8480	Designed for the same applications as regular H-type conveyor chains and refuse chains but has larger diameter rivet, greater ultimate strength for more rugged duty in general drag conveyor service applications.	9	6.00 to 8.00	42,000 to 56,000
	Combination Chains—C-55, C-77, C-1028, C-102½, C-110, C-110-C, C-111, C-111-C, C-131, C-131-C, C-132, C-132-C, PW-132, C-188, MW-188	Very rugged and serviceable for use in bucket, transfer and many other types of conveyors. Widely used in cement, chemical, lumber, quarrying, mining industries. Available in pin and cotter assembly or riveted construction.	C-3-132 RF-12 F-2 G-6-19 K-1-2-3 LL-25	1.631 to 6.050	9,000 to 50,000
5531	Dairy Conveyor MC-33	Extensively used in dairy and bottling industries, designed for both horizontal and lateral turning. Detachable construction, interchangeable with manufacturers' standard 4250, available only in extra strength Promal.	0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	2.500 only	12,000
	ley bushed Chain-823, 825, 830, 844	Developed for hard, rugged service under extremely abrasive and other adverse conditions. Used extensively in conveying or elevating sand, gravel, cement and in similar industries where service demands are rigid.	K-2 F-2	4.00 10 6.00	19,000 to 40,000

your free copy of the Moline Conveyor Chain Manual and Design Engineers Handbook



MOLINE MALLEABLE IRON CO., St. Charles, Illinois Specializing in the manufacture of chains

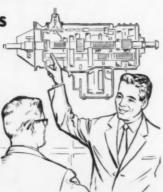
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BETTER COMPONENTS... BETTER PRODUCTS!

Cooperation produces the final design

When each component part is the best, the whole machine is right. Rockford Over-Center Clutches are the finest made for crawlers, cranes and other heavy-duty equipment. If your equipment is in the design stage, let Rockford Clutch engineers help you select the best clutch. Rockford Clutches in standard sizes suit almost every need. Custom models can be designed for your applications. Call or write for the Rockford Clutch Catalog.



ROCKFORD CLUTCHES

ROCKFORD CLUTCH DIVISION

ROCKFORD, ILLINOIS

BORG-WARNE

Export Sales
Borg-Warner International
36 So. Wabash, Chicago, III.

Circle No. 25 on Reader Service Card

NEWS continued

iron particles fill the gap to make a solid connection between the two plates, transmitting torque.

The clutch is used in an automatic transmission offered as optional equipment on the Hillman Minx cars. It's produced under rights granted by Eaton to Smiths Motor Accessories Ltd., London.

Offer lubricant R&D for new equipment

FORT WORTH, TEX.—A research and development program to help manufacturers of heavy-duty equipment has been set up by Lubrication Engineers, Inc. The firm offers its services and products free or, at most, at actual cost, for developing precise lubrication specifications or custombuilt lubricants.

Purpose of the program is to help manufacturers get the best lubrication to meet extreme lubrication needs of new and experimental equipment. Its scope will range from providing special lubricants in testing programs to engineering new lubricants for specific applications.

Michigan Tool has new division

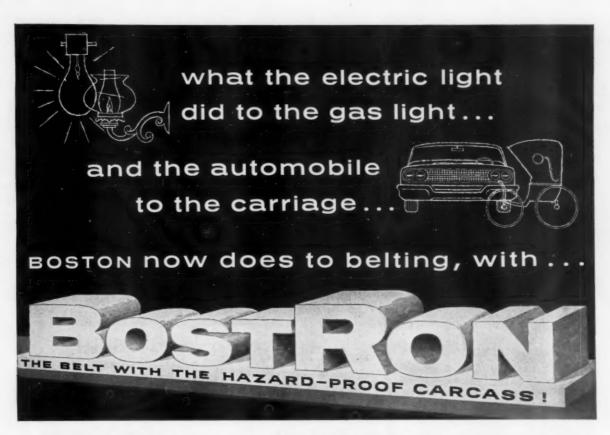
DETROIT, MICH.—A new division with complete facilities to produce spur, helical, and bevel gears and splines in prototype and developmental quantities has been set up by Michigan Tool Co. The Enterprise Div. was formed by combining a number of previous facilities with the newly-acquired facilities of the former Enterprise Gear & Tool Corp.

The division will fill the need for prototype or pilot-type production between laboratory development and actual production.

Eaton divisions name sales reps

CLEVELAND, OHIO—Cleveland Worm & Gear and Farval Divs. of Eaton Mfg. Co. have appointed engineering sales representatives in Cleveland, Pittsburgh, and Philadelphia to replace the Dingle-Clark Co. which recently retired from the agency business.

In Cleveland, it's the R. V. Robison Co. Robison formerly headed



BOSTRON HAZARD-PROOF CARCASS MAKES ORDINARY BELTING OBSOLETE

- BostRon Belts will not rot or mildew
 . . . are completely resistant to the deteriorating effects of moisture.
- BostRon Belts' impact resistance has proven superior to ordinary belts in severe field service.
- BostRon Belts' amazing carcass flexibility permits troughing up to 45° instead of the usual 20°. This permits larger loads, lower handling costs and narrower conveyor widths.
- Bostron Belts are not affected by belt fastener rust, acids or chemicals normally encountered.

An exclusive research milestone by

BOSTON SINCE 1880

AMERICAN BILTRITE RUBBER COMPANY
BOSTON WOVEN HOSE & RUBBER DIVISION
BOSTON 3 MASSACHUSETTS

lighter because of their superior strength. Handling, installing and storing are easier. Less headroom is required, and pulley diameters can be reduced up to one-third.

BOSTRON Belts can be thinner and

 BostRon Belts' ability to resist fatigue substantially prolongs mechanical splice life.

Bostron plies are stronger than steel yet have all the advantages of fabric. New Bostron Belts combine a hazard-proof carcass with Balanced Belt Construction and make your investment in a superior Dulon Cover the most sensible and dollar-saving way to purchase belts today!

Company Name		
Please send free illustrated hazard-proof BostRon Belts.	l literature about the	new
BOSTON WOVEN HOSE & Boston 3, Massachusetts	ER COMPANY RUBBER DIVISION	



It is just plain common sense to "Look before you leap" when selecting a flexible coupling.

An inferior coupling causes wear and damage to your machines — resulting in high maintenance costs and costly

shut-downs.

Troublesome maintenance problems are eliminated when you specify Thomas "All-Metal" Flexible Couplings to protect your equipment and extend the life of your machines.



COUPLING CO.
WARREN, PENNSYLVANIA, U.S.A.

Circle No. 29 on Reader Service Card

NEWS continued

Dingle-Clark's Cleveland office, assisted by J. E. Peters and E. J. Gruber who became part of the new agency.

The J. P. Murray Co. evolved from the Dingle-Clark organization in Pittsburgh. J. P. Murray had been in charge of the Pittsburgh office. With him will be former associates G. L. Engelbret, L. B. Abrams, and T. F. Hatch.

In Philadelphia, W. S. Stilwell, also previously with Dingle-Clark, rejoins with T. B. Ryan and S. G. Lugar.

American Pulley has new sales territory

PHILADELPHIA, PA.—The American Pulley Co. has created a sales territory with headquarters in Cincinnati. The territory includes southeastern Indiana, southern Ohio, Kentucky, and central Tennessee. Edward Boate has been named district manager of the Cincinnati territory.

Western Gear names distributor

LYNWOOD, CALIF.—Western Gear Corp. has appointed Electric Motor Works, Grants Pass, Ore., distributor for its gearmotors and speed reducers. A substantial inventory will be maintained for prompt delivery.

Opens large bearing quality control lab

MUSKEGON, MICH.—Kaydon Engineering Corp. has completed a new quality control laboratory for highly-accurate measuring of bearings up to 15 ft. in diameter. Precision gage setting and measuring facilities permit measurements to five millionths of an inch. All environmental conditions are controlled, including temperature, humidity, air currents, and dust.

Build 1100 hp engine

SAN DIEGO, CALIF.—Solar Aircraft Co. has developed an 1100 hp gas turbine engine for marine and industrial heavy duty applications. A constant-speed version of the engine will be used for generator and compressor drive; a variable-speed version will be used to drive pumps and for

marine propulsion. The engine also will be used in heavy, off-highway equipment.

Vickers appoints rep

St. Louis, Mo.—Vickers Inc., Electric Products Div., has named another sales representative for its dry magnetic particle clutches and brakes. It's the J. W. Vaughan Co., Greenville, S. C.

Cincinnati Gear expands

CINCINNATI, OHIO—The Cincinnati Gear Co. is building an addition to its gear plant in Mariemont, Ohio. The new two-story structure will add about 10,000 sq ft of manufacturing and office space. It will be completed this fall.

CBBI meeting set

EVANSTON, ILL.—The Cast Bronze Bearing Institute will hold its annual meeting October 12 at the Grove Park Inn, Asheville, N. C., preceding the annual meeting of the Non-Ferrous Founders' Society there October 13-15.

The CBBI, an affiliate of NFFS, is the technical and educational organization of cast bronze bearing producers.

MEETINGS

SEPTEMBER

- 14-16 National Petroleum Association, Annual Meeting, Hotel Traymore, Atlantic City, N. J.
- 15-16 American Institute of Mining, Metallurgical, and Petroleum Engineers, Engineering Management Conference, Joint Committee, Morrison Hotel, Chicago, Ill.
- 6-16 Production Engineering Show, Navy Pier, Chicago.
- 6-16 Machine Tool Exposition, International Amphitheatre, Chicago.

OCTOBER

17-19 American Society of Mechanical Engineers-American Society of Lubrication Engineers, Lubrication Conference, Statler Hilton Hotel, Boston, Mass.

30-

Nov. 1 National Lubricating Grease Institute, Annual Meeting, Edgewater Beach Hotel, Chicago, Ill.



Fawick Airflex assures split-second stops

... maximum protection for intricate tooling

Instant starting and stopping action of FAWICK Airflex Clutches and Brakes gives you positive insurance against costly machine jamming and tool or die damage.

Frantz Manufacturing Company, Sterling, Illinois, has been receiving this benefit for the past ten years on their two FAWICK-equipped butt hinge curling machines. Here, a \$500 investment in CB Airflex Clutches and Brakes is saving \$2500 annually in maintenance and production costs.

Former manual controls required constant operator attendance. Set-ups were uncertain. Machines were subject to frequent jamming and tools were often broken. The FAWICK units, with operating controls placed at strategic points around the machines, eliminate the hazard. Set-ups are quick and exact. Machines can now be stopped conveniently for product inspections, resulting in closer tolerances and higher quality.

Protecting intricate tooling is just one of the many ways in which FAWICK power transmission equipment can help you cut costs. For details on other benefits, contact your nearest FAWICK representative or the Home Office, Cleveland, Ohio.

FAWICK AIRFLEX DIVISION FAWICK CORPORATION

9919 CLINTON ROAD • CLEVELAND 11, OHIO Fawick Canada, Ltd., 60 Front St., West, Toronto, Ont., Canada



CB Airflex Clutches and Brakes mounted on beltdriven shaft are controlled from convenient push

button locations, assuring safe operation without damage from jamming or malfunction of complex machinery.

INDUSTRIAL CLUTCHES AND BRAKES

NEW! DUAL TORQUE-LOCKING AND POSITIONING DEVICE

REV-LOK eliminates feedback torque, provides two-directional positioning, drive, over-running and backstopping

NOW! You can have positive and instantaneous stopping of feedback (reverse) torque—it will never reach the driving equipment. For, the complement of sprags in this new Formsprag device is divided into two opposing sets that: instantly stops feedback from either direction, assures equalized radial loading, evenly distributes wear for longer life, and provides multi-contact surfaces for greater holding strength when high feedback torque occurs.

When the device is mounted with the outer race in a fixed position, feedback is stopped by wedging of sprags between output member and I.D. of fixed outer race—feedback never reaches the input shaft. Yet, this new design permits free rotation and transmission of high driving torque in either direction from input to output shaft. Current catalog models are available in ratings up to 30,000 lbs/in. and with bore diameters to $2\frac{1}{2}$.

When used as a two-directional over-running clutch, output shaft member is mechanically secured against rotation and outer race then becomes the output member. A slight right or left rotation of input shaft disengages either set of sprags and determines direction of drive, over-running and backstopping.

This versatile device can also be used for two-speed drive and reversing applications. By connecting a low-speed reversible motor to outer race and a high-speed motor to input shaft member, driving torque can be transmitted at two speeds or reversed.

Smallest standard Rev-Lok sizes (%" and %" shaft diameters, 96 lbs/in. output and holding capacity) have the following additional features: mounting flange on outer race, end-to-end or coaxial drive, completely enclosed and permanently lubricated, economical sleeve bearings and roller type contacts.

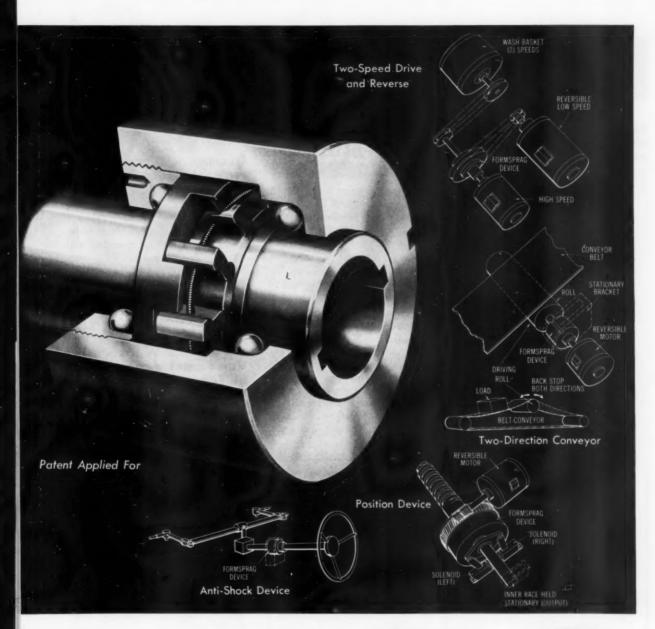
Rev-Lok devices not only drive, position, over-run and backstop in two directions, but they also provide automatic, instantaneous and positive prevention of feedback from driven equipment to power source. They are compact, have greater torque capacity for their size and weight and permit higher over-running speeds than any similar device. Formsprag technical paper provides further details on operation and features, send for your free copy.

FORMSPRAG COMPANY, 23587 Hoover Road, Dept. 105R, Warren (Detroit), Michigan Distributors in Principal Cities.

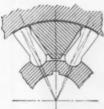


ORMSPRAG COMPANY

Precision Power Transmission Products



BECAUSE there is a complement of sprags arranged in opposing pairs, there is always a multiple number of contact surfaces engaging the outer race when feedback or backstopping conditions are present. This provides equalized radial loading and strong holding torque against even unusually heavy feedback.



The entire complement of sprags, which is a part of the output member assembly, rotates at driving speed while outer race remains stationary. Thus, sprags are in light contact with the outer race and are always in position to pick up the feedback load at constantly changing points on the outer race. This design feature assures longer life through even distribution of wear over entire surface of outer race. With sprags in constant contact with outer race, any independent movement of output shaft causes instantaneous locking of sprags—there is no backlash on output shaft.

RAWSON Centrifugal Clutches

No-Load Motor Starts, Cushioned Starting of High-Inertia Loads, Overload Protection.



OTHER FORMSPRAG PRODUCTS

FORMSPRAG Over-Running Clutches

For Every Over-Running, Indexing & Backstopping Application



MEN of the power transmission field

Eaton's Witzenberg elected ASLE president

CHICAGO, ILL.—Lee O. Witzenburg, sales manager of the Cleveland Worm & Gear and Farval Divs., Eaton Mfg.



WITZENBURG

Co., was elected president of the American Society of Lubrication Engineers.

Other new officers: Dean M. Cleve-

land, Bendix Products Div., Bendix Corp., vice president at large; W. E. Hoch, Viscosity Oil Co., treasurer; A. E. Cichelli, Bethlehem Steel Corp., secretary.

New directors are: S. R. Calish, Jr., California Research Corp.; L. E. Hoyer, American Brake Shoe Co.; A. A. Raimondi, Westinghouse Research Laboratories.

Changes at Allison

Indianapolis, Ind.—Because its bearings department was consolidated into the transmissions operations, Allison Div., General Motors Corp., made these executive changes: Edgar G. Davis, former manager, bearings department, is now manufacturing manager, transmissions operations; Hugh C. Kirtland, former chief engineer, transmissions applications, now manager of quality control; William J.

Purchas, Jr., former chief engineer, bearings department, now chief engineer, applications; Paul J. Lindley, former manager of quality control, now manager of reliability; P. G. Martich, former bearings sales manager, now in transmission sales.

Quamme is Dipco regional manager

Melrose Park, Ill.—Dayton Industrial Products Co. has appointed J. O. Quamme regional manager to work out of Dallas. Quamme, formerly industrial hose product manager, will handle sales and regional administration of industrial V-belts, sheaves, industrial hose, urethane, and special molded rubber products. His territory includes Texas, New Mexico, Louisiana, Oklahoma, Arkansas, Colorado, and Wyoming.

Name sales manager at Fafnir Bearing

NEW BRITAIN, CONN.—Stanley G. Fisher has joined Fafnir Bearing Co. as general sales manager. He'd been with Landers, Frary & Clark for 14 years, most recently as vice president and general sales manager.

General Trading appoints Acton

St. Paul, Minn.—Richard L. Acton has been named industrial sales manager for General Trading Co., a division of H & B American Corp., Los Angeles. He'll handle all industrial accounts, including railroads, mines, manufacturing companies and commercial outlets.

Acton has been in engineering and sales for nearly 30 years, and has served with Whitney Chain Co., Gilmer Div. of U. S. Rubber Co., and J. E. Rhoads & Sons.

Beatty rejoins Eaton

CLEVELAND, OHIO—Robert D. Beatty, Jr., has rejoined Eaton Mfg. Co. as a staff representative on special assignments. He started with the company in 1933, leaving to become president of Manor Die Cast Corp. in 1947. He remained there until recently, when the firm was sold.

PTD's publisher elects Aurbach, Joseph

CLEVELAND, OHIO—Lester P. Aurbach has been elected president and Edwin M. Joseph executive vice president of The Industrial Publishing Corporation, publisher of Power Transmission Design. Aurbach, formerly executive vice president, succeeds Irving B. Hexter who died recently. Aurbach joined The Industrial Publishing

Corporation in 1935, was appointed vice president three years later, executive vice president in 1952.

Joseph joined the company in 1945 as general manager of Occu-PATIONAL HAZARDS magazine. He was named a vice president in 1952 and first vice president in 1959.



AURBACH



JOSEPH

Widell heads marketing at Wagner Electric

St. Louis, Mo.—New vice president in charge of marketing at Wagner Electric Corp. is Carl E. Widell. He



WIDELL

succeeds Harold N. Felton, who remains as a vice president in an advisory and consulting capacity.

Widell, who joined the firm in 1940, will be responsible for overall marketing activities of both electrical apparatus and automotive braking equipment divisions. He became director of research and development in 1956, and two years ago joined the marketing division.

Appoint two at Worcester Gear

Worcester, Mass.—Worcester Gear Works, Inc., has named Stanley J. Paterak superintendent of all production, and James W. Barker assistant superintendent. Paterak formerly was chief analyst and scheduler at the Boston Navy Yard.

Timken names Frederick

Canton, Ohio—The Timken Roller Bearing Co. has appointed R. L. Frederick executive director, International Div. He'll coordinate Timken Roller Bearing Co. International operations. Frederick joined Timken in 1940 and most recently was assistant to the president.

Dayco promotes Confer

DAYTON, OHIO—L. J. Confer, formerly head of belt engineering, Dayton Rubber International, a division of Dayco Corp., has been named to a newly-created technical staff position to expand the division's technical service to overseas firms licensed to manufacture Dayton V-belts and

SAVE SPACE, WEIGHT, COST WITH NEW, COMPACT



Pictured Drives Compared:

For 30 HP with 1.4 Service Factor—Savings Vary with Other Drives

	Sheaves			Belts		Center	Weight		Cost			
	00 1	Driver	00	Driven	Face	Number	Size	Distance			Per HP	Per Drive
QD V-Belt Drive	8	.4"	1	6.4"	53/8"	5	C75	19.7"	108.5	44.3	\$2.81	\$124.45
QD Hi-Cap Drive	7	.1"	1	4.0"	31/4"	4	5V710	18.6"	90.2	47.0	\$2.33	\$109.96
Hi-Cap Saves	15	5.5%	14	1.6%	43%	20%		5.6%	16.9%	+6.1%	17.1%	11.6%

After more than two years of toughest use-testing, Fort Worth introduces the Hi-Cap Wedge Drive. Supplementing conventional V-belt drives, Hi-Cap Wedge is recommended for . . .

- COMPACTNESS Where a more compact drive is desired than possible with conventional V-drive equipment.
- SAVINGS In installations above 10 horsepower, Hi-Cap Wedge compares in cost favorably to the conventional V-drive; above 25 horsepower, Hi-Cap will provide cost savings over most other drives.
- NEW APPLICATIONS Extending the V-drive application range, Hi-Cap
 Wedge offers advantages for many installations where other types of
 belt drives or chain drives have been common.
- RATIOS AVAILABLE Hi-Cap Wedge stock sizes provide selection of sheave and belt sizes to assure systematic coverage of speed ratios in evenly spaced increments.

All Hi-Cap Wedge sheaves are new designs, using the same QD bushings as conventional QD sheaves and QD roller-chain sprockets.

Compactness of Hi-Cap Wedge drives is made possible by removal of "fat" from belts but without sacrifice of sidewall contact with sheave grooves. This and super-strong Green Seal cords give belts greater power-transmission capacity with less bulk.

For the name of your nearest FORT WORTH Distributor, write to . . .



FORT WORTH 1, TEXAS

V-BELT DRIVES-ROLLER-CHAIN DRIVES-SCREW CONVEYORS-INDUSTRIAL FANS

Warehouse Stocks in Fort Worth, Jersey City, Memphis, Atlanta, Chicago, St. Louis, Kansas City, Houston, Oklahoma City, Denver, Los Angeles, San Francisco; Sales Office in High Point, N. C.

Distributors Inquire about Franchises, Select Areas Available Now
Circle No. 11 on Reader Service Card

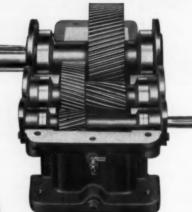


Fast Delivery on Custom Requirements

Specify H&S Helical Speed Reducers Single · Double · Triple Reduction

You get fast action when you come to Horsburgh & Scott with your speed reducer and gearing prob-

We are able to meet your specifications-or design and build to your specific needsproducts of highest quality, backed by the experience and reputation of many years as leaders in the gearing field.



Maintaining one of the largest stocks of patterns and blanks . . . special equipment and special tooling-much of it designed and built in our own plant-enables us to engineer and produce a wide range of custom gearing and transmission requirements, economically and practically as fast as you can obtain them from stock sources.

Overall design conforms to **AGMA** specifications

Write for details on wide size and capacity range of H&S Speed Reducers-Helical, Herringbone, Worm Gear and combinations.





The HORSBURGH&SCOTT CO.

5112 Hamilton Avenue · Cleveland 14. Ohio

Specializing in fast production of quality Speed Reducers and Gearing to meet custom requirements, Circle No. 15 on Reader Service Card

MEN continued

other industrial rubber products.

Confer will help these firms coordinate product specifications with the standards of the Rubber Manufacturers Association, automotive and agricultural engineering societies. American Petroleum Institute, American Standards Association, and the U. S. Armed Forces.

Millward Thomas Dies

WARREN, PA., -Millward T. Thomas, founder of Thomas Flexible Coupling Co., died recently at the age of 85. Mr. Thomas, who founded the



THOMAS

company in 1917, was active as president and managing officer until his death. He will be succeeded as president by Richard H. Crook, a director and former advisor to Mr. Thomas.

Warner Electric promotes Hone

BELOIT, WIS.-Warner Electric Brake & Clutch Co. has named Stanley B. Hone manager, factory sales.



HONE

He'll supervise inside sales personnel and coordinate distributor sales activities. Hone had been a field representative in the San Francisco office.



12" Texalon Belt provides constant even flow of power on compressor at Philip Carey Manufacturing Company, Plymouth Meeting, Pa. Atmospheric conditions
meant short life for drive belts at Philip
Carey Manufacturing Company, Plymouth
Meeting, Pa. It took three to four days to replace
10 "D" section V belts on a compressor. Perfect
fitting was difficult. Loss of power due to slippage was
a constant problem.

To eliminate costly down-time, Carey switched to Texalon, the new nylon core synthetic belting by Rhoads. Texalon is easily made endless in minutes. After six months, the Texalon belting still shows no sign of wear. Carey has no slippage problems . . . they get a smooth dependable flow of power.

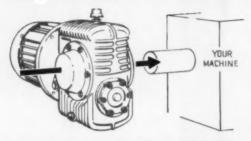
At Rhoads, experienced belt drive engineers recommend the flat belt that is exactly right for your job.

Literature on request. Address: Engineering Department, J. E. Rhoads & Sons, 2100 W. 11th Street, Wilmington 99, Delaware.

RHOADS

Established 1702 . . . Pioneers in Mechanical Power Transmission Circle No. 39 on Reader Service Card

CONE-DRIVE GEARMOTORS for "PLUG-IN" POWER



Hollow-Shaft Speed Reducer-Motor forms complete power transmission package . . .

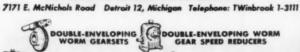
With the compact, right-angle Cone-Drive gearmotor the machine designer can make use of an integral drive package of nearly any required speed and horsepower. Twenty-seven standard output speeds from 7.3 to 525 RPM (with 1750 RPM motor) are available in models from ¼ to 40 horsepower. Gearmotors can be specified with hollow shaft for mounting in any position, ready to "plug-in". You can use this integrated power package to provide a simple, clean installation on your machine . . . no pulleys, belts, sheaves, bed plates, couplings, etc.

Electric motors are standard "D" flange type with slight shaft modification for driving helical primary reduction gears. Secondary reduction stage is a standard Cone-Drive double-enveloping worm gearset with maximum tooth engagement for greater load carrying capacity in smaller space.

Cone-Drive gearmotors are available for all AGMA service ratings. Call your Cone-Drive representative today or write for catalog #58 for complete specifications.

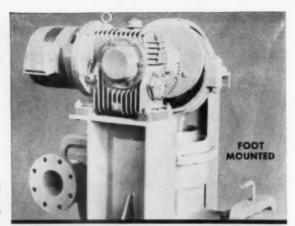
CONE-DRIVE GEARS

DIVISION MICHIGAN TOOL COMPANY





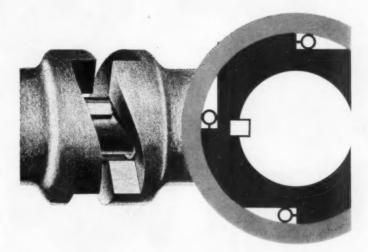
DOUBLE-ENVELOPING RIGHT ANGLE GEARMOTORS











An introduction to . . .

Positive - contact clutches and brakes

- · Jaw
- Gear
- Overrunning
- Overload release

MECHANICAL clutches and brakes, as opposed to electrical and hydraulic types, for power transmission include friction¹ and positive-contact types. This article will cover positive-contact types. Although the term positive-contact is usually applied to jaw and toothed clutches, overrunning, single-revolution, and some overload-release clutches also depend on positive mechanical interference to transmit power.

Gear and Jaw Clutches

Positive-contact clutches are typified by jaw and gear clutches, Figure 1. There are many variations in the design of the engaging members. But, they all have the following common characteristics:

- 1. No slippage
- 2. No heat generated
- 3. Engagement at high speeds not advisable
- 4. Engagement accompanied by shock
- Engagement may be impossible if neither member is turning.

The many variations in design of the engaging members are usually attempts to increase the probability of engagement when the connected members are not rotating. Both shape and number of engaging members may vary. If the number is small, the probability of not being able to engage the members is increased.

By proper shaping of the teeth or jaws, engagement may be greatly simplified, but at the cost of limiting power transmitting ability to only one direction of rotation, Figure 1b.

Positive-contact clutches using crown tooth construction, Figure 2, represent the highest degree of refinement in clutches of this type. They may be engaged at speeds to 300 rpm and disengaged at any

¹Friction clutches and brakes were discussed in An Introduction to Friction Clutches and Brakes. Power Transmission Design, June, 1960, page 19.

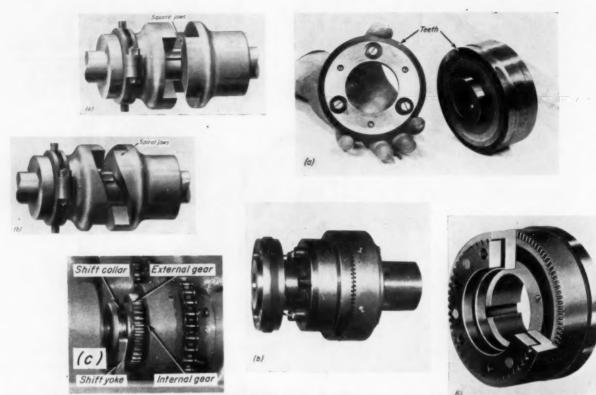


Fig. 1. Some typical positive-contact clutches. Spiral jaw type, b, simplifies engagement but design causes members to be forced apart if drive direction forces spiral faces into contact. Good installation procedure is illustrated by the gear clutch installation, c, where shift mechanism is connected to the member which does not rotate when the clutch is disengaged.

Fig. 2. Some typical face- or crown-tooth clutches. These are all electromagnetically operated. Many teeth are used to increase probability of engagement when neither member is rotating. This also reduces angular displacement during engagement, This is an important consideration on precision feed drives and positioning drives.

CLUTCHES AND BRAKES continued

speed. These are available from many manufacturers as complete, ready-to-use units for electromagnetic operation. Many miniature electromagnetic clutches are crown-tooth types.

There are a few instances where clutches are designed to combine features of friction and positive-contact types. One unit, Figure 3, combines a multiple-disc clutch and a sliding gear unit. The friction clutch is used to synchronize rotation of the meshing portions of the gear clutch so engagement can be made at high speed.

Similar means are used in automotive transmissions to permit engagement of sliding gear-type clutches. One of the clutch members is an integral part of the gear to be engaged.

With the exception of the electromagnetic, crowntooth clutches, there are few stock positive contact clutches available. However, there are many sources. Most gear manufacturers are experienced in producing these, both as clutch units and integral parts of gears.

Sizes: Mechanically-shifted units may be had in virtually any size and torque capacity. Electromagnetically-

operated, crown-tooth units are available in sizes from a few in.-lb to 32,000 ft-lb.

Styles: Positive-contact clutches may be mounted on through shafts or overhung with the driven member connected to a gear, sprocket, sheave, etc. They can also be clutch-couplings for connecting two shafts. Another variation is the clutch-coupling incorporating features of flexible shaft couplings to let it compensate for misalignment, angularity, offset, and end float. It's important to remember that clutch-coupling design does not always mean the unit has the flexible coupling features.

Miniature electromagnetic units are completely housed and have double shaft extensions for connecting to driving and driven members. Miniature units are available with a friction brake in the same housing and as duplex units—two clutches in the same housing.

Overload Release Clutches

Designs of positive-contact overload-release clutches vary widely. However, they all have one common characteristic. Torque-transmitting members are designed so the transmitted torque tends to cause the members

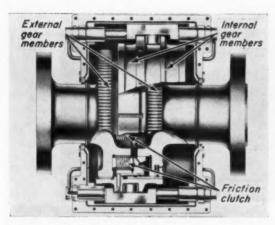


Fig. 3. A multiple-disc friction clutch is used to synchronize driving and driven gear members in this positivecontact clutch unit so they can be engaged at high speed.

to disengage. Springs are used to hold driving members in engagement, or one of the driving members may, itself, be sufficiently flexible to serve as the spring. Figure 4c.

When the overload-release clutch disengages, there are two possible modes of operation. One is for the clutch to positively disengage and not re-engage until externally reset, even though torque drops back below the limiting value. The other way is for the clutch to repeatedly engage and disengage as the members rotate relative to each other. This usually involves mechanical noise, or clicking. The noise is thought to be a desirable signal of the overload in some instances.

In certain overload clutches, the mechanical movement which occurs when the torque rating is exceeded may be used to operate a limit switch. Limit switch operation may then be used to operate a bell or horn to give audible warning of the overload, or the switch may be used to actually shut down the drive.

Sizes: Off-the-shelf units of this type are available for torques from a few in.-lb to 50,000 in.-lb. Much larger sizes may be designed and built to order.

Styles: These clutches are designed for through-shaft mounting, overhung mounting, and clutch-coupling mounting. Variations include units with integral flexible couplings and integral sprockets. All are made for easy mounting of sheaves, sprockets, gears, etc.

Overrunning Clutches

There are many variations in overrunning clutch design, Figure 5. They all have the common characteristic of permitting overrunning or freewheeling when input rotation slows or stops. Overrunning will also occur if input rotation is reversed. In this case, there is no power transmitted by the clutch. For these reasons, overrunning clutches are also called one-way clutches.

The one-way feature of overrunning clutches has led to their use as backstop or holdback brakes. When

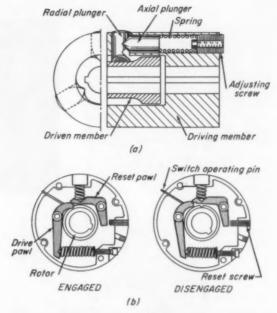


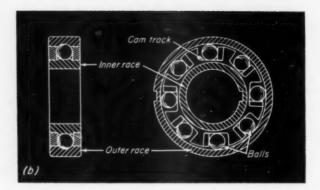
Fig. 4. Overload release clutches. Unit a has three plungers which fit in to notches in the driven member to transmit torque. Excessive torque moves these out and pushes three axial plungers away from the radial plungers. Springs then force the axial plungers back into notches in the radial plungers to hold them in a disengaged position. The mechanism must then be reset before it can transmit power. Motion of the radial plungers can be used to trip a limit switch and shut down the drive.

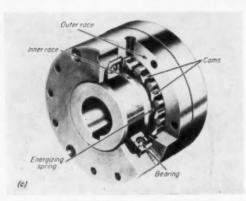
Another design, b, releases when torque overcomes force of springs behind the drive and reset pawls. As the drive pawl pivots out of the notch in the rotor, the reset pawl engages the notch in the drive pawl and holds it disengaged. The switch-operating pin may be used to shut down the drive.

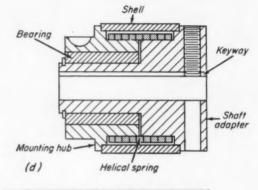
In the third clutch shown, c, three leaves fit into notches between three ridges to transmit torque between driving and driven members. When torque rating is exceeded, the leaves are forced out of the notches and ride along the ridges. Each 120 deg of rotation, the leaves drop back into the notches, If the overload is relieved, the clutch will drive again.

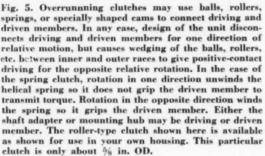


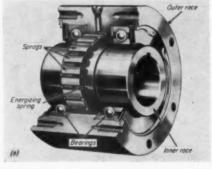












CLUTCHES AND BRAKES continued

used in this way one of the members is anchored to some stationary member. Then, for one direction of rotation the brake offers little or no resistance to rotation. But, if the connected shaft starts to turn in the opposite direction, it is immediately stopped.

Typical backstop applications are on inclined conveyors and elevators. Here they prevent motion in the reverse direction due to gravity in the case of power failure or during normal shutdown. A similar application where backstops are used is on windup drives where they prevent unwinding due to tension in the material being wound when the drive is shut down.

Dual drives, where two prime movers are used, often use overrunning clutches to make use of one prime mover or the other easy. The same setup is used with standby power sources, Figure 6.

Sizes: Overrunning clutches are available with torque ratings from less than 1 in.-lb to more than 130,000 ft-lb. Physical sizes of these units range from $\frac{1}{2}$ -in. OD units for $\frac{1}{8}$ -in. shafts (weight = 0.5 oz) to 32-in. OD units for 12-in. diam shafts.

Styles: All overrunning clutches are available for through-shaft or overhung mounting. Some manufacturers will provide them integral with a flexible coupling for clutch-coupling mounting. Another variation is a completely housed unit for foot mounting with dual extended shafts for connecting to drive and load. These units are recommended for use in very dirty and dusty places, and also where continuous uninterrupted service is very important.

The housed clutch unit makes this possible because it is not necessary to shut down to change oil in the clutch or grease it. Also, this construction allows removal and replacement of one of the prime movers in a dual drive system without ever shutting down.

Overrunning clutch units are also available as just the operating parts, or roller assembly, for mounting in the user's housing.

Other applications: An overrunning clutch may be compared to a ratchet with an infinite number of teeth. For this reason, these clutches are often used as indexing devices. When the input member is driven by a crank or some other sort of oscillating drive, the clutch will not transmit the motion during the reverse portion of the input cycle. Thus, the output is interrupted, unidirectional rotation which can be used for rotary or linear indexing. Linear indexing would, of course, require a rack and pinion or ball screw to convert clutch rotation to linear motion.

Specially-modified overrunning clutches, Figure 7, are available to give on-off control in addition to the overrunning feature. Clutches of this type are sometimes called single-revolution clutches since it is possible to allow only one revolution of the output member by releasing the control member and then stopping it one revolution later. Although the name single revolution is used, rotation may be any number of revolutions wanted by simply not holding the control member. These clutches may be used for less than one revolution.

Since the single-revolution clutches discussed are modified overrunning clutches, the load may continue to rotate when drive power is removed if it has enough inertia. In such cases, an auxiliary brake may be necessary to stop the driven mechanism. One spring-type clutch is specially designed for this type of service. Friction and the spring moment are used to brake the load.

One manufacturer packages a single-revolution clutch complete with a solenoid for control, a brake to stop the connected load when the clutch disengages, and a non-repeat mechanism to assure only one revolution no matter how long the solenoid is energized. This unit may also be had for fractional revolution rotation, with a maximum of eight stops in 360 deg., Figure 8.

Another modification of the overrunning clutch is the two-direction backstop. Although these clutches may be used for many more things than two-direction backstopping, this helps to explain what they do. Stated in another way, rotation of the input in either shaft is freely transmitted to the output shaft, but any rotation of the output shaft in either direction is instantly braked within the unit and not transmitted to the input shaft. These units have been used in vehicle and boat steering systems to prevent forces applied to wheels or rudder from being transmitted to the steering wheel. An explanation of the operation of one of these accompanies Figure 9.

Selection: Speeds and torque ratings are specified by manufacturers in their literature. These must be matched to the conditions of the application. This sounds simple enough, and is, but there are a few precautions. In general, either the inner or outer race of an overrunning clutch may overrun. But, with very few exceptions, permissible overrunning speed for the

Fig. 6. This sketch illustrates two of the more common applications of overrunning clutches. Connected in this way, either prime mover can drive the load, or the high-speed drive can be started and drive the load faster than the low-speed drive. The low-speed drive would then just run idle.



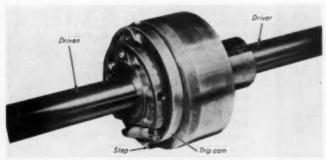


Fig. 7 As long as the trip cam of this single-revolution clutch is held by a pin or lever against the step, rollers of the overrunning ciutch unit are mechanically discngaged. When the cam is released, the unit functions as an overrunning clutch.

Fig. 8. Packaged single-revolution clutch is complete with control, brake, and other features. Output is always unidirectional.



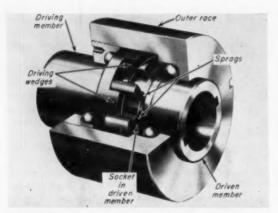


Fig. 9. Way this two-direction backstop works is shown by this cataway view. Wedge-shaped member between two opposing sprags is the input or driving member. When it turns, it pushes the sprag it bears against out of engagement with the outer race (outer race is held from turning). It then drives the inner race through this same sprag which is socketed in the inner race at its base. The sprag not contacted by the driving wedge is carried along and due to geometry does not wedge against the outer race. If the output member is turned by a force from the output end, it causes one or the other of the pair of sprags to bind against the outer race. Thus, no rotation can be transmitted from output to input. The pair of sprags and driving wedge shown are, of course, just one of reveral such sets spaced around the clutch unit.

CLUTCHES AND BRAKES continued

outer race will not be the same as for the inner race, and the difference can be as much 5:1 in ratio.

In a few cases overrunning must be restricted to one race or the other. This depends on design and should be checked in the manufacturer's literature. Overrunning speed incidentally is not necessarily synonymous with speed of the overrunning member. It is the relative speed of driving and driven members. Only when speed of one member is zero are overrunning speed and speed of the overrunning member synonymous.

Because of the relative rotation of the members of an overrunning clutch, lubrication is required. Completely sealed models are available. Where the clutch is to be used inside a gearbox, open models which can be satisfactorily lubricated by the gear oil are available.

REPRINTS AVAILABLE

Reprints of this article, together with the 10page article, An Introduction to Friction Clutches and Brakes, which appeared last month, will be available as a single 16-page reprint. Prices are: 75c each, 1-9 copies; 50c each, 10-49 copies; 35c each, 50 or more copies. Send orders to:

> Reprints, Power Transmission Design 812 Huron Road Cleveland 15, Ohio

Directory of Positive-Contact Clutch Manufacturers

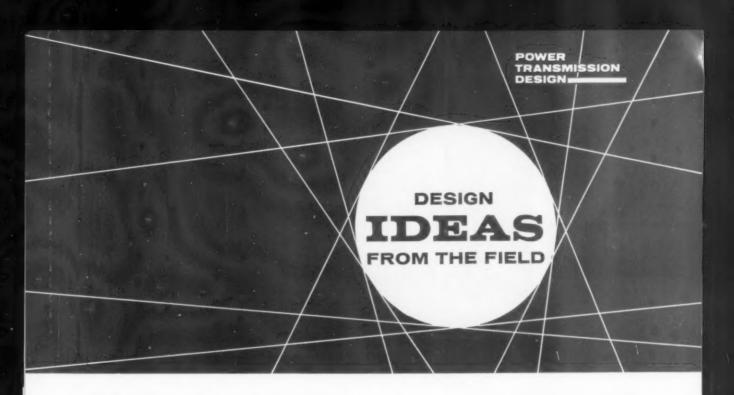
Manufacturer	Types Manufactured
Actuator Products Corp	
Centric Clutch Co	
Chain Belt Co	
Curtiss-Wright Co., Marquette I	Div 4, 5, 6
Dings Brakes Inc	
Dynamic Instrument Corp	
Digitronics Corp	
Eclipse Machine Div., Bendix C	orp
J. B. Ehrsam & Sons Mfg. Co.	
Formsprag Co	
Gleason Works	
The Hilliard Corp	4
I-T-E Circuit Breaker Co	
Jeffrey Mfg. Co	
Link-Belt Co	
Machine Accessories Inc., Subsid	liary Reveo Inc
Marland One-Way Clutch Co	
Medart Engineering and Equip	ment Co
The Miniclutch Co	
Morse Chain Co	
Odin Corp	
PIC Design Corp	
Rochester Bevel Gear Corp	
Royersford Foundry and Machin	
Stearns Electric Corp	
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KEY-

- Jaw, gear, etc. clutches,—manually or mechanically operated.
- Electromagnetically-operated crown-or face-tooth clutches.
- 2a. Miniature electromagnetically-operated crown- or face-tooth clutches.
- 3. Overload release clutches.
- Overrunning, or one-way, clutches, backstops.
- 5. Single-revolution clutches.
- 6. Two-direction backstops.

Acknowledgement

Co-operation of the following companies in providing
the noted illustrations is acknowledged with thanks.
Centric Clutch Co
Curtiss-Wright Corp., Marquette DivFig. 5d
Dings Brakes Inc
Do-All CorpFig. 1c
Eclipse Machine Div., Bendix Corp Fig. 2e
Formsprag CoFigs. 5e, 9
Hilliard CorpFigs. 7, 8
I-T-E Circuit Breaker Co
Jeffrey Mfg. CoFigs. 1a, 1b
Machine Accessories Inc., Subs. Reveo Inc Fig. 4e
The Miniclutch Co Fig. 5a
Morse Chain Co
Odin Corp
Zurn Industries Inc



Full-floating flywheel, low-inertia clutch take strain off driveshaft

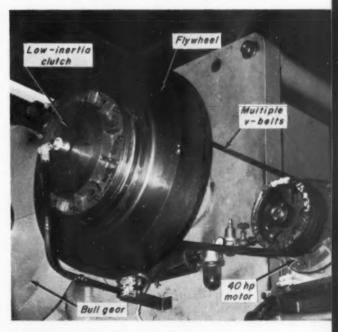
IT TAKES A LOT of machine to bend 8 ft of 1-in. steel plate, and it takes well-designed rotating components to make its mechanical muscles work.

A machine that meets both requirements is a 500-ton (medium duty) mechanical press brake made by Verson Allsteel Press Co., Chicago. It's the Series B-20, which has the added feature of 2-speed operation.

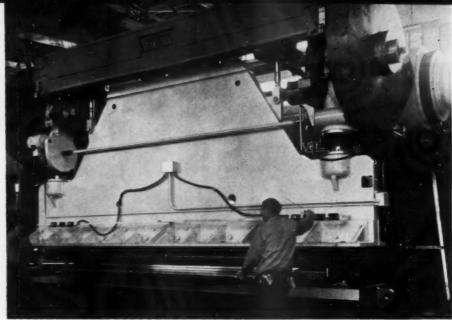
There is plenty of wallop packed in the machine's flywheel, turned by a 40-hp motor through multiple V-belts. It weighs 4000 lb, is 49 in. in diameter, and rotates at 600 rpm. When the clutch is engaged, the flywheel delivers a portion of its high energy to the work.

There is enough work for the shaft to do without making it carry the weight of the clutch and the flywheel. For this reason, the flywheel is quill-mounted and a low-inertia clutch is used. The quill is stationary and is supported by the machine frame. The flywheel revolves around the quill on two roller bearings. The driveshaft turns inside the quill and is supported by two roller bearings and one ball bearing.

The clutch is bolted to the flywheel. The only part of this clutch assembly that is supported by the drive-shaft is the lining disc. This is very small as compared to the 4600-lb clutch and flywheel assembly which on



CLUTCH-FLYWHEEL assembly on 500-ton press brake.



continued

IDEAS

PINION SHAFT runs across press brake to drive bull gears at either end.

FULL-FLOATING FLYWHEEL continued

many machines is carried on the clutch shaft.

The low-inertia clutch, at one end of the driveshaft, is air-operated and normally disengaged. There is a low-inertia brake at the other end of the driveshaft, and it is normally engaged. So if the power fails, the clutch disengages and the brake goes on. Also, the clutch and brake are electrically interlocked.

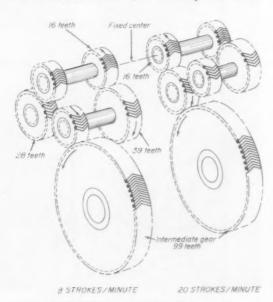
While two speeds are unusual in this type of machine it is done simply. A manual speed-change lever engages one of two gear sets to deliver either 20 or 8 strokes a minute.

For 20 strokes a minute, a 16-tooth pinion on the

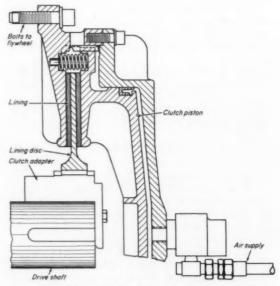
driveshaft meshes through a 28-tooth idler, to the 99-tooth intermediate gear. The ratio is slightly more than 6:1. The intermediate gear turns a long shaft with pinions on either end to drive the large bull gears that impart press motion through eccentrics and pitmans.

For 8 strokes a minute, another 16-tooth pinion on the driveshaft meshes with a 39-tooth gear on a pinion shaft. A 16-tooth pinion on this shaft then drives the intermediate gear. This ratio is about 15:1.

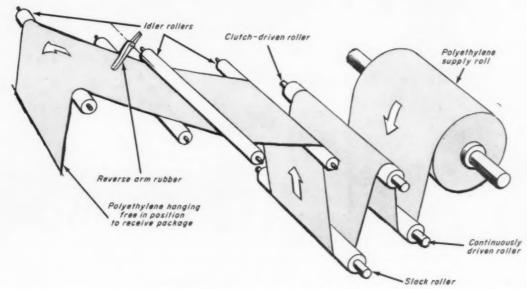
All gears are herringbone, because they are strong and quiet. They also are heat-treated for added strength.



STROKE SPEED is changed by simple gear sets.



CLUTCH's lining disc is only weight on driveshaft.



SLIGHTEST TUG on free end of polyethylene is enough to engage clutch drive.

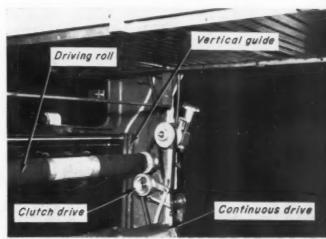
Friction clutch responds to slightest tension

DELICATE RESPONSE to tension engages the friction clutch of a sensitive drive for feeding polyethylene film or other material in a bread-wrapping machine. The machine, designed by the Bakery Div., American Machine & Foundry Co., wraps and seals up to 6000 loaves an hour.

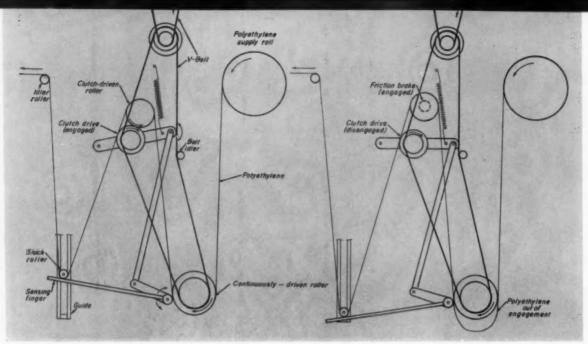
The friction clutch, which turns a driving roller, is spring-actuated. A slack roll, under which the film passes, weighs just enough to counteract the pull of the spring when there's no tension on the film.

The slight tension caused by a loaf being frictionwrapped is enough to raise the slack roller. A sensing finger follows the slack roller upward and, through a pivoted arm, lets the spring pull the clutch against the driving roller.

When the wrapping cycle is finished and the polyethylene is cut, tension is removed. The slack roll drops, the sensing finger goes with it, and the clutch is disengaged. At the same time, a spring-type fric-



CLUTCH-DRIVE detail of bread-wrapping machine.



CLUTCH DRIVE is engaged (left) until tension is removed (right) to disengage it.

FRICTION CLUTCH continued

tion brake stops the inertia-rotation of the driving roller to prevent overfeeding.

The supply roll also is controlled by tension. When the friction drive is engaged, taking up slack in the film, the film is pulled against a continuously-driven roller. This roller pulls the film with just enough force to overcome the inertia of the supply roll. When tension is relaxed, the film drops away from the roller and a friction brake stops the supply roll. Both brakes also engage if the wrapping material tears.



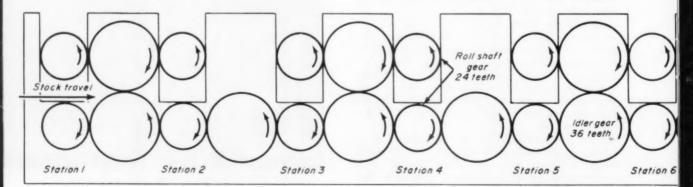
One shaft drives 78 gears

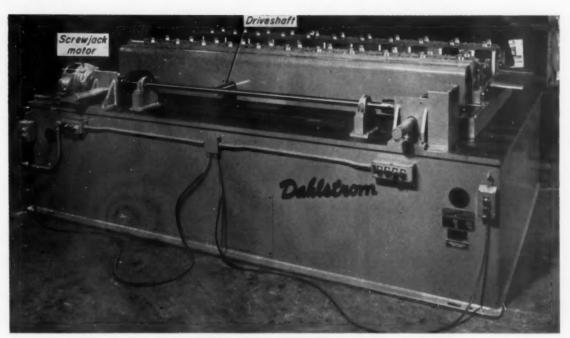
IMPRACTICAL to entrain 39 spur gears? Or to drive two such trains with one driveshaft? Not at all. Dahlstrom Machine Works, Inc., Chicago, does it effectively in a dual-head cold roll forming machine. This machine, the Model 450/2, handles 16-gage

edges by running them between forming rolls. These rolls are tooled to form the sheet gradually as it passes through 11 stations.

metal blanks, 211/2 to 32 in. wide. It shapes their

The forming roll setup is the same on either side.





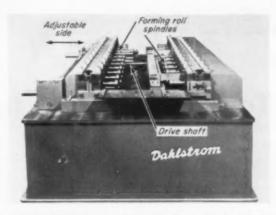
DRIVESHAFT extends from side of machine. Screwjack moves one side laterally.

Each of the 11 stations has a pair of forming rolls. Each roll is mounted on a 2-in. spindle and is gear-driven. Driving all gears with a single drive shaft synchronizes the rolls so they pull the sheets evenly.

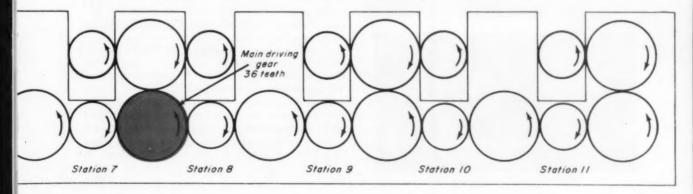
Let's count the gears. Each forming roll spindle has one, making 22. The top row of spindles is driven by 5 idlers, the bottom row by 11. Add the main driving gear and you get 39 on either side, or 78 in all. The spindle gears have 24 teeth; the idlers and driving gears have 36.

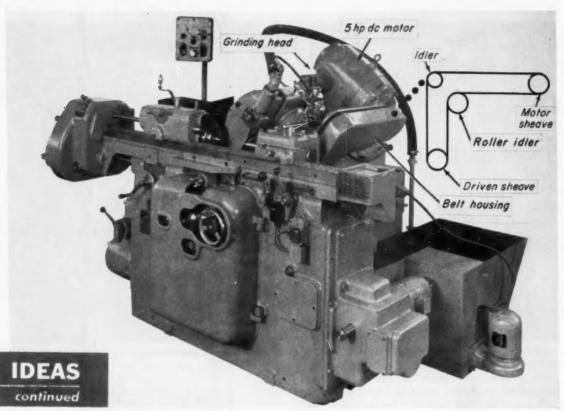
A 15-hp motor turns a 72-tooth sprocket on the driveshaft through three strands of ¾-in. roller chain. The 2½-in. driveshaft runs across the machine, connecting the forming sets. One of the forming sets, which adjusts for different blank widths, slides along the keyed shaft. For this reason, its driving gear is made with a wide, slotted sleeve.

A separate motor powers a screwjack to move the adjustable set of forming rolls.



ALL 44 SPINDLES are driven by the single driveshaft, and the adjustable side slides along this shaft (above). Driving gear and idler setup (below) is the same for either side of machine.



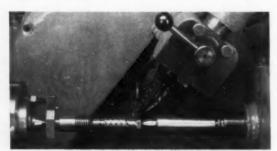


RIGHT-ANGLE BELT DRIVE was part of modification of automatic thread grinder.

Toothed belt drive helps save \$57,000

IF YOU CAN'T DRIVE through, go around. This common sense, applied to a belt drive, helped cut \$57,000 off the cost of a machine.

Janette Electric Mfg. Co., Morton Grove, Ill., makes motors and speed reducers. They use automatic thread grinders to cut 20° and 30° helix angles in worm gears. When production requirements warranted additional equipment for grinding helix angles greater than 30°, it was decided that a standard thread grinder would be rebuilt and modified to grind all helix angles up to and including 45°, both left and right.



GRINDING HEAD is tilted to cut helix angle.

Rather than pay \$72,000 for a new machine, they got a modified version of their standard grinder for \$15,000. It was specially redesigned and rebuilt for Janette by Machine Tool Rebuilders, Inc., of Niles, Ill. This firm rebuilds all types of industrial machines and designs special machines.

With the standard drive—multiple V-belts direct from motor to grinding wheel—the driving head couldn't be tilted 45° because part of the machine was in the way.

The obstacle was sidestepped by making a 90° turn. However, the V-belts were too thick to bend at such a sharp angle. Also, with the driving head at 45°, the V-belts would tend to ride on the sides of the pulleys. This would add more belt slippage than that already caused by oil mist from the grinding lubricant. Too much slippage creates chatter.

The solution was a 1-in. toothed belt running in grooved sheaves. It could take the 90° bend without strain. Being toothed, it wouldn't slip when exposed to oil or when tilted at 45°. In fact, Janette tested the machine by taking a ½-in. cut in a solid bar. It held close tolerances with no vibration, no chatter marks.

















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SHAFTS OF BOTH main motors are extensible, power ripper head through right angle gear boxes on each side of machine.

Telescopic motor shafts drive coal mining rippers

By WILLIAM G. YOUNG, chief engineer, miners, Joy Manufacturing Co.

SHAFTS OF THE TWO 100 hp main motors in a new continuous miner are coupled together to power the ripper head. The ripper head digs the coal and protrudes from the front of the miner with a series of chain loops and teeth. It rotates at 213 rpm. Two motors are used instead of one because of limited ceiling height.

The shaft of each motor is coaxially splined to telescope 24 in. This lets the operator advance the ripper head without advancing the whole crawler or stopping the motors. The motor shafts extend axially with respect to the motor housings.

The motors may be either ac or dc. They are located symmetrically on each side of the miner. Their output shafts drive through right angle gear boxes which drive both ends of the ripper head drive shaft. Five-ripper chain driving sprockets are mounted on the ripper head shaft. So, as the operator digs coal, he has positive driving torque from both motors, feed distance equal to the extensibility of the motor shafts, and swing distance up and down, left and right.

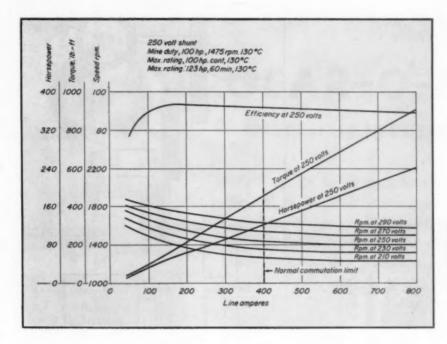
The miner has eight motors altogether. The main

motors operate the ripper head only. Two 30 hp motors provide traction. Two 15 hp motors power the chain conveyor which carries the coal from the front to the rear of the machine. Coal exits onto a follow-up conveyor making handling completely automatic. One 15 hp motor powers the hydraulic system. The remaining 15 hp motor operates the clean-up unit under the ripper head. The clean-up picks up loose coal from the mine floor and moves it back to the conveyor for removal.

When d-c motors are used, they are started in parallel at the same time, with two steps of resistance in series with each motor. The resistance is timed out by using magnetically-operated mercury switches after starting.

When a c motors are used, they are started one at a time at two second intervals. The inrush current of one motor is somewhat greater with this method but the total inrush is less than if both motors were started at the same time.

The design of the cutting chain, sprockets, gears, and other driven equipment determines the maximum speed of the motors at idle load. In the d-c system,



CURVES SHOW compounding of d-c motors that provides idle-speed characteristics at loaded conditions.

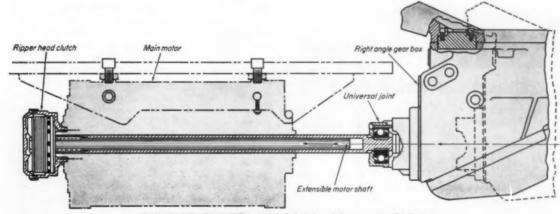
the motors are compounded to maintain as much of the idle load speed as practical throughout the working range of the motor. In this way, they yield a large amount of horsepower per cubic foot of motor space and yet are able to keep both armature currents in balance so that each motor shares the load equally throughout the working range.

Resistors provide starting loads in fewer steps than in most industrial applications. This is necessary since space is not available for a large number of contactors and resistors.

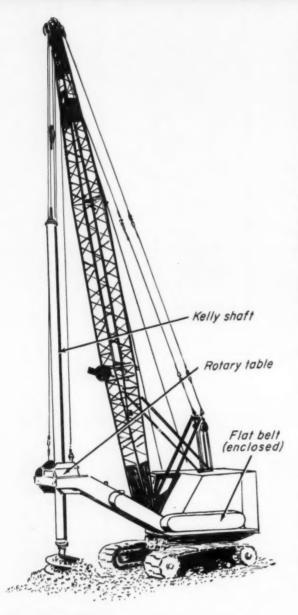
The ripper chains do the actual work of digging the coal. They are adjusted in the mines for maximum tonnage. The links and straps are made of forged steel. The two right angle gear boxes that drive the ripper bar have right angle bevel gears powered by the two motors. A 65 tooth pinion gear in each gear box engages the ripper bar.

Constant velocity universal joints connect the motor shafts to the gear boxes. This prevents vibration and sine-wave rotary motion of the ripper head.

The two main motors operate at low and peak torque equally well. A problem that was overcome in the design was compounding to prevent one motor from taking more than its share of the load at peak torque. The motors remain quite stable and do not overheat. Peak torque is held at 75% of rated torque so that overtorquing cannot be accomplished.



CONSTANT-VELOCITY universal joint joins motor shaft to right angle box to keep motion smooth and free of vibration.

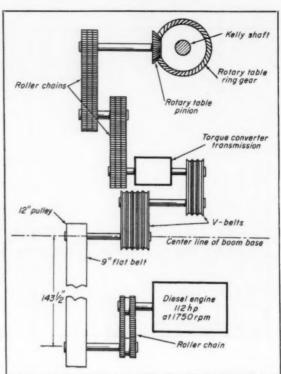




takes shock loads without slip

SUDDEN ACCELERATION, 12-ft centers, high torque. When Case Foundation Co., Kennyville, Ill., put them together, belts began to slip.

They use an auger-equipped Bucyrus-Erie 30-B power crane to dig footing holes for apartments and other heavy structures. With a 4-ft auger, this crawler-



DRIVE COMPONENTS of auger-equipped crane.

mounted rig can dig 100 ft in about 20 minutes. The Kelly shaft driving the auger develops 2860 lb-ft torque at 100 rpm.

Digging is easy. Removing dirt isn't. If you don't remove the loose dirt frequently, you might jam the auger. To get the dirt out, you stop the auger, pull it out of the hole, and give it a sudden spin. The dirt packed on the auger flies off, away from the hole.

This sudden spin puts a terrific shock load on the drive, but it must be done. If the auger were started up gradually, the dirt would trickle off, and some of it would fall back in the hole.

The Kelly shaft holding the auger mounts on the crane boom. Power comes from the crane's engine. Trouble is, it's 12 ft from engine to boom. Originally, multiple V-belts were used to span this distance. While they worked fine for digging, they slipped when the auger was spun.

Case then tried a 9-in. flat belt with a polymer tensile member and leather friction surface. It worked. The belt runs on 12-in. round-crowned, dynamically-balanced pulleys. It accelerates to 8300 fpm without slip, despite its length.

The drive starts with the engine, a Caterpillar diesel, developing 112 hp at 1750 rpm. Through double strands of roller chain, it drives a jackshaft carrying the input pulley of the flat belt. Output from the belt goes through multiple V-belts to a torque converter and transmission. Then, through a triple-chain drive, it's transmitted at 300 rpm to the rotary table that turns the Kelly shaft. A pinion-gear drive on the rotary table reduces shaft speed to 100 rpm.



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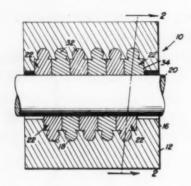
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PATENTS

Shaft bearing

U. S. Patent No. 2,916,338; Ben E. Muschalek, Jr., McCamey, Tex.

Spiral grooving in the bearing housing contains a number of bearing segments shaped to fit the groove.

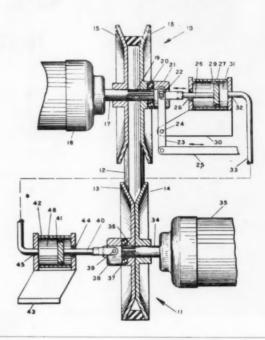


Retainers at either end of the spiral groove hold the segments in place and force their ends into abutment with each other to make a continuous, smooth bearing surface.

Variable-speed belt drive

U. S. Patent No. 2,916,927; Lincoln I. Opper, Dayton, Ohio, assignor to The Dayton Rubber Co., Dayton, Ohio.

Diameter varying means of two variable-pitch sheaves are connected by hydraulic pistons in such a way





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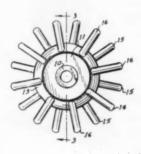


that variation of pitch diameter of one sheave causes axial motion of the attached piston. Motion of the one piston is transmitted to the other by a hydraulic fluid to actuate the pitch changing mechanism and cause a corresponding change in the pitch diameter of the other sheave.

V-belt sheave

U. S. Patent No. 2,916,925; John R. Padrick, Anniston,

This sheave is made up of a hub which tapers to an



apex at the periphery. Alternately spaced fingers extend from each side of the hub to grip the V-belt.

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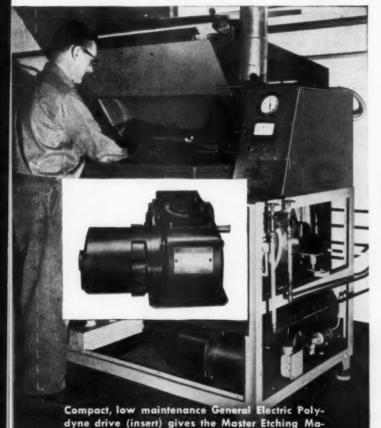
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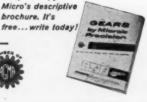
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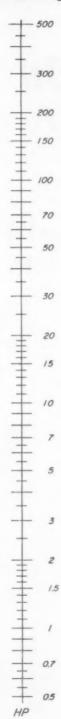


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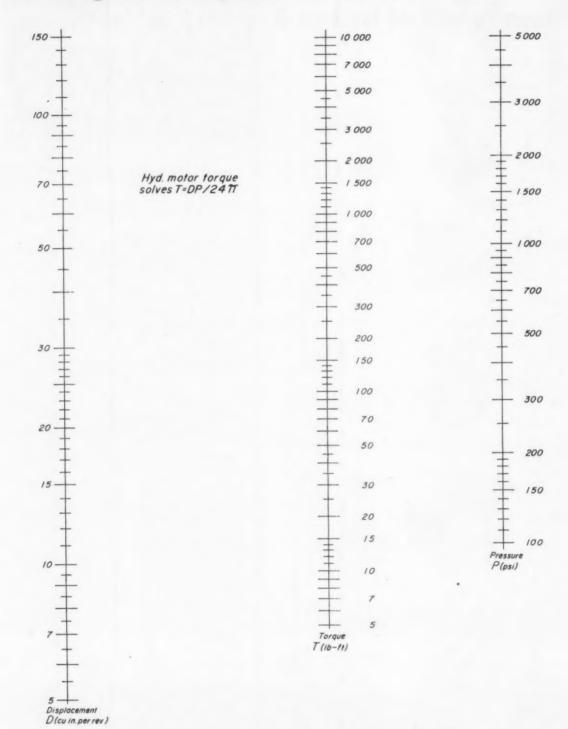
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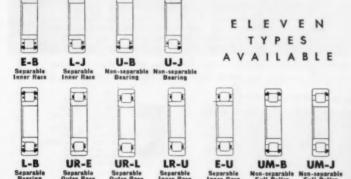
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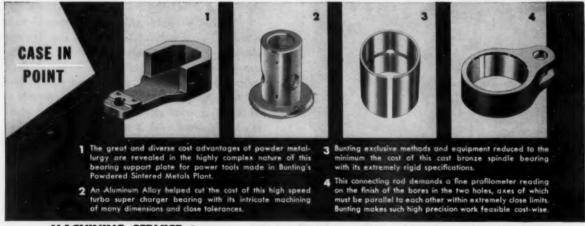
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BEARINGS DESIGN/APPLICATION

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New standards

simplify selection and buying

By J. HOWARD DONAHUE, Pioneer Steel Ball Co. Inc., Unionville, Conn.

SIMILARITIES in appearance, shape, accuracy, and hardness of balls for bearings and other uses make it hard for users to compare competing products. The user's lot is made even more difficult if different manufacturers use different designations for balls of the same accuracy. There's a real need for standardization in designations as well as accuracy,

A recent revision of the AFBMA (Anti-Friction Bearing Manufacturers Association, Inc.) Standards For Balls includes a method of grade identification. This method is fully accepted and used by all ball

manufacturers. See Table I.

The grade designations in Table I-3, 5, 10, etc.are not arbitrary. They are the maximum allowable diameter tolerance in millionths of an inch. For example, a Grade 100 ball has a diameter tolerance of 0.0001 in., or 100 millionths of an inch. Unlike previous standards, this holds true regardless of the material or size of the ball.

Tolerances in Table 1 also reflect improvements in manufacturing precision and measuring devices. Smallest tolerance in the previous standards was 0.00001 in.; the new is 0.000003 in.

Grade designations and the corresponding tolerances are only a part of the new standard. There are

five major sections and an appendix, First major section on terminology defines basic terms used in discussing balls and their specifications. Twenty commonly-used terms are defined.

Material specifications, including metal composition, are part of the next section. Materials included are: chrome alloy steel, stainless steels, carbon steel, brass, bronze, aluminum bronze, Monel, K-Monel, and aluminum. This section also specifies surface quality, geometry, hardness, and strength.

Acceptance provisions, both general and by different materials are covered in the third and fourth major sections. Sixteen tables list tolerances, crushing loads, sizes, minimum case hardening depths, etc., for the

different kinds of balls.

Fifth major section is an appendix to the standards. It suggests methods and apparatus for measuring and testing balls. It has tables showing the number of balls to the pound in different materials and sizes, and tables comparing this standard with the previous one.

Copies of the new standard may be obtained from your ball supplier or from the Anti-Friction Bearing Manufacturers Association, Inc., 60 E. 42nd Street, New York 17, N. Y. The AFBMA charges 50 cents a copy.

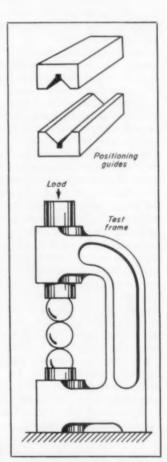
Table I-AFBMA Ball Grades and Tolerances

Grade	Size Range (diam in.)	Diam tolerance per ball (in.)	V block out-of-round in 120 deg angle (in.)	Diameter tolerance unit container (in.)	Basic diameter tolerance (in.)	Marking increment (in.)	Maximum Surface Roughness (micro-in.) 1. 2
3	1/32-1"	.000003	.000003	.000005	±.00003	.000003	.5
5	1/32-1-1/2"	.000005	.000005	.00001	$\pm .00005$.000005	.7
10	1/32-1-1/2"	.000010	.000010	.00002	$\pm .0001$.000010	1.0
15	17/32-1-1/2"	.000015	.000015	.00003	$\pm .0001$.000015	1.2
25	1/32-1-1/2"	.000025	.000025	.00005	$\pm .0001$.000025	1.5
50	1/32-2-7/8"	.00005	.00005	.0001	$\pm .0002$.00005	Not
100	3"- 4-1/2"	.0001	.0001	.0002	$\pm .0005$.0001	Applicable
200	1/32-2-7/8"	.0002	.0002	.0004	$\pm .0010$.0002	
300	3"- 4-1/2"	.0003	.0003	.0006	$\pm .0015$.0003	
500	1 -11/32-4-1/2"	.0005	.0005	.001	$\pm .002$.0005	
1000	1/32-4-1/2"	.001	.001	.002	$\pm .005$	-	

Table II-Present and Previous Grade Designations

F	revious	Standard		Present	Standard	*
Material	Grade	Size Range (in.)	Grade	per ball	Diam. tol. Per cont. (in.)	Basic diam tolerance (in.)
Chrome	0	1/2MM-1/2	10	.000010	.00002	±.0001
Alloy	0	17/32-1	15	.000015	.00003	$\pm .0001$
Steel	1	1/16-1-5/16	25	.000025	.00005	$\pm .0001$
	1	1-11/32-2-7/8	50	.000050	.0001	$\pm .0002$
	1	3	100	.0001	.0002	$\pm .0005$
	2	1/16-1-5/16	50	.000050	.0001	$\pm .0002$
m.	2	1-11/32-2-7/8	200	.0002	.0004	$\pm .0010$
	2	3	300	.0003	.0006	$\pm .0015$
	3	1/16-1-5/16	200	.0002	.0004	$\pm .0010$
	3	1-11/32	500	.0005	.001	$\pm .002$
	4	1/16-	1000	.001	.002	$\pm .005$
Stainless	0	1/16-2	50	.000050	.0001	$\pm .0002$
(corrosion	0	2- 1/8 -	100	.0001	.0002	±.0005
resisting,	1	1/16-2	100	.0001	.0002	$\pm .0005$
hardened	1	2- 1/8	200	.0002	.0004	±.0010
steel)	2	1/16- 5/8	200	.0002	.0004	$\pm .0010$
Carbon	Al	1/16-1	100	.0001	.0002	±.0005
Steel	A2	1/16-1	200	.0002	.0004	±.0010
	A3	1/16-1	300	.0003	.0006	$\pm .0015$
	A	1/16-1	500	.0005	.001	$\pm .002$
	В	1/16-1	1000	.001	.002	$\pm .005$
	C	1/16-1	2000	.002	.004	$\pm .005$
Brass	1	1/16- 3/4	200	.0002	.0004	±.0010
	2	1/16- 3/4	500	.0005	.001	±.002
Bronze	1	1/16- 3/4	200	.0002	.0004	±.0010
Dionze	2	1/16- 3/4	500	.0002	.001	±.002
Aluminum	1	13/16 and	200	.0002	.0004	$\pm .0010$
Bronze		larger				
Monel	1	1/16 and larger	200	.0002	.0004	±.0010
	2	1/16	500	.0005	.001	$\pm .002$

^{*}For complete list of grades, see Table I.



CRUSHING TEST FRAME use is described in appendix to lat-est AFBMA ball standard. Guides are used to position three balls for test.

¹ Arithmetical Average.
² These grades may carry waviness requirements.

New gas bearing design gives increased load capacity

By C. R. ADAMS, research engineer, Boeing Airplane Co., Aero-Space Div.

BEARINGS in airborne accessory equipment must work in extremely low or high temperatures, with low friction, and where they might be exposed to radiation. One type that meets these requirements is the gas bearing.

Gas bearings may be externally-pressurized or selfacting. The externally-pressurized bearing has the supporting pressure supplied from an outside source. The self-acting bearing depends on a pressure wedge developed during rotation to support the load (Figure 1). Since externally-pressurized bearings can support greater loads, they're better for accessory power applications.

You must design each gas bearing for its application. You must understand and consider all operating conditions, as well as manufacturing tolerances, the gas to be used, variations in pressure and temperature, the amount available, availability during starting and stopping, and gas contamination. Although mathematical analysis of a design's capability is valuable, operation under conditions imposed in the actual installation usually shows changes must be made.

Most externally-pressurized radial gas bearings get gas through a ring of small orifices around the journal (Figure 2). In these bearings, the gas is throttled through the orifices as it enters. Pressure buildup around the shaft is determined by eccentricity of the shaft in the journal, since clearance controls the leakage rate.

You may use pressure pockets to increase loadcarrying capacity (Figure 3); however, the added volume of trapped gas may cause instability. Bearings with sintered or porous material to meter gas flow have been tried, but their use has been limited because porosity is hard to control.

The step-dam design

Boeing has developed an externally-pressurized bearing with many outstanding features. It's simple, inherently stable, and easy to make. This bearing throttles the gas as it leaves the bearing, rather than as it enters (Figure 4). Dams or steps machined on either the shaft or journal do the throttling.

Without a step on the shaft or housing, pressure cannot build up under the shaft to produce lift (Figure 5). Leakage at the top of the shaft causes the pressure to drop in an almost straight line from inlet to atmospheric. This pressure acts as a locking force.

With a step on shaft or housing, pressure builds up under the shaft and creates lift (Figure 5). Pressure drops off to atmospheric as the gas flows out the gap at the top of the shaft. Since the flow rate through the gap at the top of the shaft is greater than the flow rate at the bottom, there is a greater pressure drop at the top. This difference provides the lift necessary to float the shaft.

Overcoming problems

Shaft expansion due to centrifugal force could possibly reduce bearing clearance at very high speeds. This will not be a major problem in most applications. We have demonstrated this by successfully operating a 2.00 in. diameter step bearing shaft with .001 in. diametral clearance at 40,000 rpm.

Thermal expansion doesn't seriously affect step bearings when shaft and housing are made of the same material. In tests at 600 F with a 2 in. shaft, a diametral clearance of .002 in. adequately prevented seizure even during transient conditions with maximum temperature difference between the shaft and housing. It may be possible to reduce the diametral clearance to .001 in. or less where the difference in temperature between shaft and housing is kept within 50 F.

Load-carrying capacity may be reduced if two or more gas bearings on one shaft are misaligned. For this reason, production should be sequenced so that journals can be line bored. Bore diameter must be concentric within .0001 in. to get uniform load-carrying capacity. A simple way to do this is to complete all grinding operations with a single machine setup.

A good surface finish is desirable, but not as important as maintaining straight bores and parallel

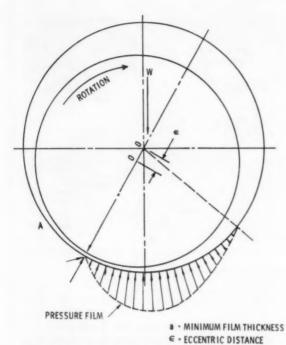


FIGURE 1. In self-acting gas bearings, loads are supported by pressure wedges developed during rotation.

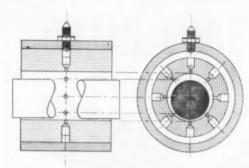


FIGURE 2. Externally-pressurized orifice bearing.

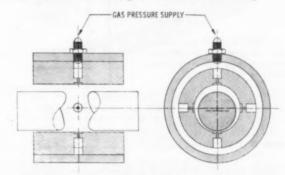
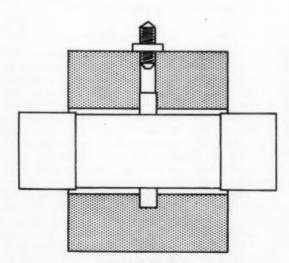


FIGURE 3. Orifice bearing with pressure pockets.

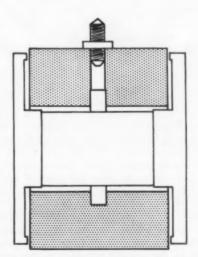
surfaces. Although surface finishes better than 16 RMS are normally used, a step bearing has been operated at high speeds with a 64 RMS surface finish on the journal.

If you lap or hone bores, you must be extremely careful to avoid bell mouthing. If a bore of 1.0000 in. is bell mouthed so its edge diameter is 1.0002, this will affect bearing capacity. And, this effect is much greater than if the entire bore were made 1.0002.

You must also contend with contamination. Generally, gas bearings are bothered more by a combination of oil and contamination particles than by contamination particles alone. We learned the step bearing was less susceptible to contamination from oil and dust particles than the multiple-orifice bearing. Using filtered plant air at 70 F, we found that one month of continuous operation generally caused the step bearing to clog up, compared to two or three



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FIGURE 4. Boeing's gas bearing has steps on shaft or journal to throttle gas as it leaves the bearing.

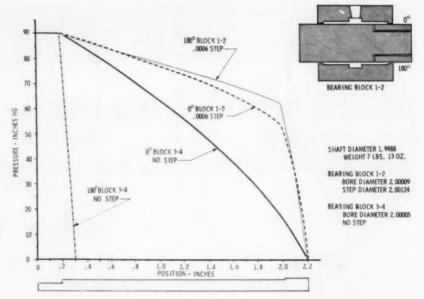


FIGURE 5. Note the difference in pressure distribution between bearings with steps and those without.

NEW GAS BEARING continued

weeks for an orifice bearing. If the supply air had been heated to burn off all oil carried through the filter, clogging would have been delayed much longer for both types.

You get higher unit efficiency when you use less bearing gas. Therefore, pressure to the bearing should be kept as low as possible to handle load fluctuations and stiffness requirements. You might consider starting equipment with externally-pressurized bearings which can be made self-acting during normal operation. However, you might affect stability by doing this.

Pressure distribution tests

We conducted a series of pressure distribution tests, starting with a simple setup to measure pressures along the top, bottom, and two sides of a 2 in. diameter shaft in a stepped bearing block. Four .013 in. pressure taps were drilled into the shaft and connected by flexible tubes to 100-in. mercury manometers. As the shaft was moved through the bearing by a positioning screw, we took pressure readings. We used this setup to get the data in Figure 5. One bearing block had a step in the bore, the other did not.

Figure 6 shows the effect of increasing the load on a step bearing. When the load is increased, the pressure difference between the top and bottom of the shaft becomes greater. It can also be observed that the pressure difference near the pressure annulus is small. This would indicate that the bearing length/diameter ratio is not an optimum,

Figure 7 shows pressure distribution curves with various bearing length/diameter ratios in the bearing. When the ratio was reduced from 1 to 45, the area bounded by the top and bottom pressures became a maximum at .7, indicating a greater lift potential at this point. The optimum ratio has not been deter-

mined, but it is probably near this .7 figure.

When we plotted pressure distribution curves of a shaft rotating at 20,000 rpm, we noted there were no attitude angles normally associated with journal bearings. This indicated there was no self-acting effect. When bearing supply pressure is lowered below that required to support the shaft statically (about 12 psi), attitude angles will show up in the curves.

A number of failures occured because shafts and journals galled from metal-to-metal contact during starts, stops, and sometimes while running. Unbalanced loads or excessive loads caused these contacts. In the step bearing, the contact area is confined to the step, so seizure is not sudden, but takes place over a number of revolutions. Gradual seizing means gradual dissipation of inertia forces, and this could be a safety feature in some applications.

Recommendations

It's a good idea to use material combinations which have a "forgiveness" factor to compensate for momentary contacts. One of our most satisfactory combinations is a flame-plated tungsten-carbide shaft operating in a Meehanite journal. Other combinations include nitrided-nitraloy shafts in Meehanite or bronze journals. Many of our tests were run with material combinations selected because of availability or machinability. These bearings were satisfactory as long as contact was prevented, but rubbing contacts usually caused early failures.

Step bearings can be modified by putting an oilmist into the gas supply. The oil will leave a thin film on the shaft and journal, and will act as a boundary lubricant to prevent seizure. The control of oil to the bearing is not critical, providing the oil bleed-off air losses are acceptable. This may be one answer to starting and stopping equipment, since the shaft can be started on an oil film while pressure

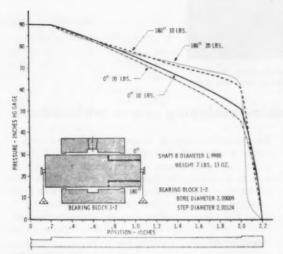


FIGURE 6. Effect of load on pressure distribution.

builds up and stopped on an oil film when pressure is lost.

A small step bearing turbine with an AISI 4340 shaft and housing could be shut down without seizure when the oil-air mist system was used. It seized almost immediately when only air was used. In these turbine tests, air supply to the bearing was cut off when turbine supply pressures were shut off.

Oil mist also was tried with multiple-orifice bearings, but was not considered satisfactory because the oil mist had to be carefully controlled to prevent filling the orifices with oil and upsetting the pressure distribution.

For high temperatures, it may be possible to use a chemical additive which forms a protective coating on the shaft and journal.

This article was abstracted from a paper presented at the SAE National Aeronautic Meeting, New York.

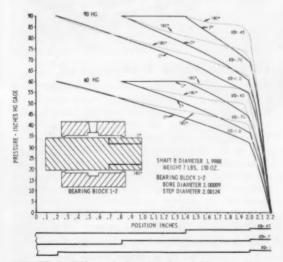


FIGURE 7. Effect of changing length/diam. ratios.

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NEW PRODUCTS

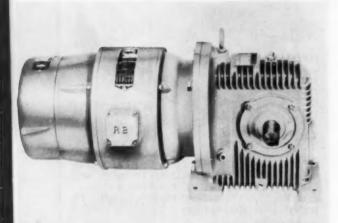
To get complete information on these products, use the Reader Service Cards bound into this issue.

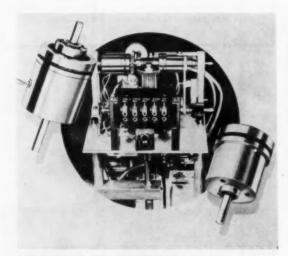
Double-enveloping worm motoreducer

This double-enveloping worm motoreducer is said to utilize a new worm and gear mating principle which gives full-depth contact of worm and gear teeth, as well as increasing the number of teeth in mesh. This full-depth mating between the worm and gear teeth increases the load-carrying contact area almost 100%. Since this greater contact area reduces unit pressure, lighter rated units can carry loads ordinarily requiring larger and heavier housings. The motoreducer is available in horsepower ratings from ½ hp through 15 hp. Speed reduction ratings, from rated motor speeds, are 525 rpm through 7.3 rpm. There's all-position mounting, with selection of feet, hollowshaft, or flange. Even greater versatility is provided by a selection of drive motors which can be combined into different packages.

Reuland Electric Co., Alhambra, Calif.

Circle No. 201 on Reader Service Card



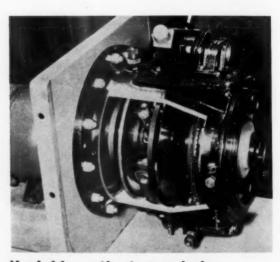


Minature clutch/brake

Miniature electric clutch and brake assemblies are being used to help a highly sensitive electronic micrometer measure objects to within 10 millionths of an inch. The brake is designed to halt a counter spindle in 7 milliseconds. The miniature assemblies are said to react with a high degree of accuracy, speed, and exact repeatability because of a patented diaphragm that eliminates sliding parts and torque-carrying splines and pins. The motor-shaft rotates an electromagnetic coil. When the coil is energized, it attracts the friction face of an armature, causing the clutch engagement.

Simplatrol Products Corp., Worcester, Mass.

Circle No. 202 on Reader Service Card



Variable ratio transmission

Basic components of a mechanical variable ratio transmission are two toroids and three rollers. The toroids face each other and form a full toroidal cavity in which the rollers are mounted on a fixed cage. Tilting of the rollers against the toroidal surface results in an infinitely variable speed ratio. Mechanical preloading of the roller-toroid components, through the toroidal axis, permits transmission of power by traction from the input to the output toroid. Output speed can be selected manually or controlled automatically. The drive is said to offer efficiencies of more than 90% over the full speed range.

Lycoming Div., Avco Corp., Stratford, Conn.

Circle No. 203 on Reader Service Card

Flexible roller chain

Extra clearance between linkplates and between pins and bushings permits up to 4 in. lateral displacement and 8° twist for each 4 ft of chain. Linkplates are straight for straightline load transmission and greater shock resistance. A drive fit needs only one linkplate, so connecting links can easily be installed in the field. Named Tuf-Flex Chain, it's available in 4 pitch sizes for sprockets cut for offset, sidebar, and standard roller chain. Offset links can be supplied for half pitch adjustments.

Diamond Chain Co., Inc., Indianapolis, Ind.

Circle No. 219 on Reader Service Card

Liquid dispenser

A multiple liquid dispenser uses air instead of a pump to meter specific amounts of liquid. Said to be the first dispenser system which can operate more than a single liquid reservoir.

Detroit Controls Div., American Radiator & Standard Sanitary Corp., Detroit, Mich.

Circle No. 220 on Reader Service Card

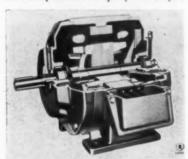
Low-cost differentials

Designed for products using lightload gearing where high precision is not required, units are intended to sell for less than 10 cents each. Low costs result from the use of zinc alloy gears and housings die cast automatically at high speed. Possible uses include reversing shaft rotation, adding and subtracting shaft movements, serving as a clutch or brake, etc.

Gries Reproducer Corp., New Rochelle, N. Y.

Circle No. 221 on Reader Service Card
Open weatherproof motor

Stator windings of an ac open motor are encapsulated in epoxy resin by a



vacuum impregnation and pressure process. This gives a uniform coating with excellent heat dissipation and high corrosive resistance and bond strength. Bearings, exposed internal metal surfaces, and all mechanical parts are also protected against atmospheric contamination for both indoor and outdoor work. Available in frames 180 through 445U, 1 through 125 hp in all standard speeds and voltages.

Reliance Electric & Engineering Co., Cleveland, Ohio.

Circle No. 222 on Reader Service Card

Flexible coupling

Model GH coupling is for heavy-duty use in sizes from 35 to 700 hp at 1800 rpm and for shafts up to 5½ in. in diameter. Load cushions separate interlocking jaws, avoiding metal contact and reducing vibration, shock loads, and misalignment. Removable inserts, held in place by a steel collar, can be replaced without disturbing driving or driven units. Inserts available for all operating conditions and government requirements.

Gerbing Mfg. Corp., Elgin, Ill.

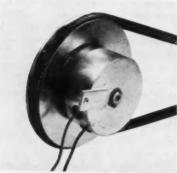
Circle No. 223 on Reader Service Card



PRODUCTS continued

Tiny positive clutch

Called Model CT 14, clutch is 1½ in. in diameter and ¾ in. long. It develops 80 oz.-in. torque and may be wound for 28 vdc. The positive



acting crown teeth are magnetically engaged and spring released. Teeth are pitched for easy engagement at low rpm, giving smooth acceleration to drive the load. A sheave can be mounted on the driven hub which serves as an armature. Other types of mounting use worm and spur gears.

Stearns Electric Corp., Milwaukee, Wis.

Circle No. 204 on Reader Service Card

Low temperature oil

Anderol L-423 is a light viscosity diester oil which features a pour point of below -105 F, and a viscosity at 90 F of 5000 C's. Combined with good oxidational stability and low evaporation, the result is a lubricant for low starting and running torques with a temperature range of -100 F to 250 F.

Lehigh Chemical Co., Chestertown, Md.

Circle No. 205 on Reader Service Card

Nylon bearing retainer

Glass fiber filled nylon retainer for a needle thrust bearing reduces sliding friction and increases bearing life. Identified as Type NJ, bearings with the new retainer are claimed to

life. Identified as Type NJ, bearings with the new retainer are claimed to

be more efficient than the all-steel model and to run cooler. Needle diameters for the entire line have been standardized at .078 in. Almost any combination of bore and OD sizes can be produced. Retainers can be color coded for easy recognition of different sizes.

Kaydon Engineering Corp., Muskegon, Mich.

Circle No. 206 on Reader Service Card

Midget industrial transmission

This transmission will convert any constant speed input into an infinitely adjustable output speed. A choice of integral control devices allows you to preset and select one or more







speeds, in one or both directions, up to 1650 rpm. Dimensions are: length 15 in., width 14 in., height 10½ in., and weight 90 lb. Starting torque is 62 lb-in., normal torque 45 lb-in., and peak torque 67 lb-in., with an approximate output of 1 hp. Standard transmission and speed control devices offer direct or remote control, manual or automatic operation, open or closed loop control systems. Also integral with these units is a gear pump, cooling fan, fluid reservoir case, and overload relief valves.

Oilgear Co., Milwaukee, Wis.

Circle No. 207 on Reader Service Card

Tension control unit

An oscillating unwind and rewind assembly has a tension control unit of the oil shear, magnetically-controlled type. Control is cooled by forced recirculation in a Young heat exchanger through an oil coolant pump. A scotch yoke bayonet lock permits heavy deflection of the shaft without strain on the components.

Web Controls Corp., West Englewood, N. J.

Circle No. 208 on Reader Service Card

Silicone shielded motors

Stator coils of a line of variable speed drives and gear motors are encased in Sterlicone, a high dielectric strength silicone sealing compound. Contamination resistance of dripproof units is greatly increased.

Sterling Electric Motors, Inc., Los Angeles, Calif.

Circle No. 209 on Reader Service Card

Variable speed sheaves

Two additional sizes, the MS-100-10 and MS-100-15, bring the number of models in the MS series to seven, covering a range from 2 to 15 hp. New models have maximum pitch

diameters of 10 in., and are rated at 10 and 15 hp at 1750 rpm. Design features a series of torsionally resilient rubber keys outside the bearing surface which transmit the belt torque. Bearing surfaces are re-oiled with each rotation, eliminating freezing from fretting corrosion.

T. B. Wood's Sons Co., Chambersburg, Pa.

Circle No. 210 on Reader Service Card

Drive tensioner

Designed to take up slack in chain and belt drives, it can also be used as an idler bracket. A rotating arm and adjusting slot permits vertical and horizontal positioning through 360°. The serrated mounting pad



WANTED!

POWER-LOAD PROBLEMS

Hydraulics, Inc. is anxious to work with industrial firms on power application problems which others have failed to

Our VariDRAULIC Drive is positively and infinitely variable in torque and speed Unmatched as a flexible, shock-free speed control between power source and work load

It's self-contained, compact No external plumbing. Gears are positive, oil smooth Available in numerous adaptions to meet your specific transmission problem Widely used by major industries



Circle No. 37 on Reader Service Card JULY, 1960

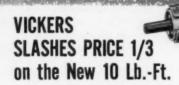
Did Someone say Sheave Clutches? Here's a graceful line-up of just a few standard models — many more available, of course. Torques range from 90 to 3200 pound inches—higher, if needed. Also available with the fabulous Stationaire. Living proof of the versatility of Conway Clutches—for every industry. WRITE FOR BULLETINS About the world's most respected name in clutches for over a

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MAGNECLUTCH DRY MAGNETIC PARTICLE CLUTCH

Substantial Improvement in Reliability, Service Life

This new low-cost, lightweight Magneclutch retains and improves all the outstanding characteristics of the older model: no wear on torque transmitting surfaces, smooth operation, torque at zero slip, etc. Larger size Magneclutches axailable to 200 lb.-ft., water or air cooled.

Watch for Announcement of Write for New Bulletin 6106-5 New 5 lb.-ft. Magneclutch on Vickers 10 lb.-ft. Magneclutch

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PRODUCTS continued

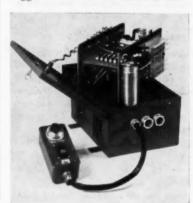
in the base mates with another serrated pad in the rotating arm. This arm is bolted in position. Fine scale adjustment comes from loosening and tightening a bolt in the adjustment slot of the base.

Brewer Machine and Gear Co., St. Louis, Mo.

Circle No. 211 on Reader Service Card

DC motor speed control

Components of the control are siliconcontrolled rectifiers and magnetic triggers. There are no tubes or mov-







REDUCERS—75 models to choose from . .spur, worm or combination gears . . . single or double reduction. Ratios up to 10,000 to 1; ratings from 1/50 to 168 hp.

GEARS—Custom-made from any gear material to your exact requirements—NO STOCKS. Pitches from 96 D.P. to 5.7 D.P. Request Gear Bulletin Send B/P and Specs or Sample for Prompt Quotation

ABART GEAR and MACHINE CO.

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That's why Johnson powdered metals—ferrous and non-ferrous—have been in demand for over 20 years. Quality and dollar-conscious engineers know from experience that Johnson powdered metal parts consistently meet material quality

and close tolerance requirements.

These engineers also know they can rely on the experience of Johnson's complete product design engineering service. It's one of the many bonuses from using Johnson powdered metal parts. Here's another: Johnson now can supply powdered metal parts up to 4 inches O.D. and 3 inches long.

If you need any parts like those shown here, call, write or wire Johnson Bronze Co.

Johnson Bronze Company

New Castle, Pa.

West Coast Plant: Oakland 8, Calif.
Circle No. 16 on Reader Service Card

PRODUCTS continued

ing parts. Advantages of this system are said to be a greater efficiency over the full speed range for less weight and size. Voltage drop is smaller and no warmup time is required. Power may be obtained from any ac outlet. Rated for de shunt motors up to 5 hp, but may be adapted for de motors of larger sizes.

ACF Electronics Div., ACF Industries, Inc., Paramus, N. J.

Circle No. 212 on Reader Service Card

Splined flexible shaft

You can transmit up to 760 lb-in. of torque around a curve at 600 rpm with this shaft. The core is 1 in. in

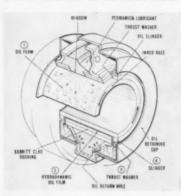


diameter and made up of layers of tightly wound music wire bound with a casing lined with oil-tempered spring steel which acts as a bearing surface. Casing is covered with a neoprene impregnated fabric and an abrasion-proof rubber jacket. The shaft features a splined slip coupling at one end which slides back and forth under load and corrects slight changes in length. Steel-backed bronze sleeve bearings support the core at each end of the shaft.

Stow Mfg. Co., Binghamton, N. Y. Circle No. 213 on Reader Service Card

New type bearings

A line of packaged bearings with a base life of 20,000 hours is said to combine design advantages of sleeve and ball bearings. Principal feature is a Permawick oil reservoir which



maintains a hydrodynamic oil film between the steel inner race and the babbitt-lined shaft bushing. There is no metal contact. The Permawick continuously absorbs and recirculates oil for the life of the bearing. Operating temperatures range from -25 to 200 F. Bores stocked from 8 to 40 mm.

Tann Bearing Co., Div. of Tann Corp., Detroit, Mich.

Circle No. 214 on Reader Service Card

Diesel transmission

A new 17-inch, three-element torque converter which has a stall torque ratio of 2.5:1 is a feature of a more powerful version of the CLBT-5940 Torqmatic Transmission. For diesels up to 525 gross hp, a new split range automatic valve body gives a possible 12-phase shift. Control is by the usual four-speed lever. Torque converter characteristics are used to increase the flow of cooling oil in a new cooler circuit so that full brake on grades can be applied for much longer periods. Torqmatic brake is optional.

Allison Div., General Motors Corp., Indianapolis, Ind.

Circle No. 215 on Reader Service Card

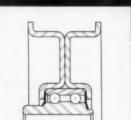
double row ball bearing idler pulleys











TYPE DRI-2

Series DRI idler pulleys feature double row ball bearings. This unique Split Ballbearing design uses a full complement of balls in each hardened raceway to provide maximum load capacity and long life. The double row bearing is more rigid than single row types, offering more resistance to overturning moments. Pulley wobble is virtually eliminated, with a consequent increase in belt life.

CHECK THESE ADDITIONAL FEATURES:

- 1. Extended inner ring permits assembly in mounting without loose spacers.
- Inch dimension bearing bores accommodate standard machine bolts as the pulley mount.
- Double sealed, and prelubricated with high quality grease for long, maintenance-free service.
- 4. Heavy gauge steel stampings resist mechanical damage in service.
- Available in several types with integral shafts. Also available for flat belts, V-belts, chain or cable.

SEND FOR CATALOG SHEET 6838 FOR COMPLETE INFORMATION



split ballbearing

A DIVISION OF MPB, INC. 605 HIGHWAY FOUR, LEBANON, NEW HAMPSHIRE

Circle No. 27 on Reader Service Card

C-flange gearmotor

Motor and reducer are separate, flange connected. The reducer alone can be supplied to fit the customer's



own NEMA motors if complete assembly is not required. Capacities from 1/12 to 2 hp, reductions from 5:1 to 60:1, in increments of 5's up to 30:1 and 10's from 30 to 60.

Morse Chain Co., Ithaca, N. Y.

Circle No. 216 on Reader Service Card

Nylon-tipped screws

Designed for gears or hubs, the soft nylon tip takes the shape of the shaft and imbeds itself in the thread hole. This gives a self-locked washer effect and prevents shaft marking. Screws have slotted or socket heads in sizes from #2-56 to ½-20, in a variety of stock sizes.

PIC Design Corp., East Rockaway, L. I.

Circle No. 217 on Reader Service Card

Adjustable-torque clutch

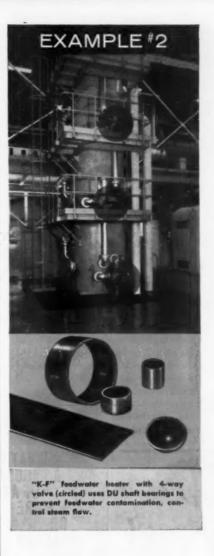
A friction clutch has a built-in slip device that soaks up overload beyond torque settings. When the overload



stops, the clutch returns to positive one-piece cast iron units which disdrive. Hub and pressure plate are sipate heat and prevent distortion. In all standard sizes for replacement and OEM uses. Also available to customer specifications.

Norwalk Tool & Die, Inc., Vickery Div., Norwalk, Ohio.

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DU*DRY BEARINGS

Solve Another Problem

"Only DU material was successful in our new 4-Way Plug Valve Shaft Bearings after four or five of the more conventional bearing materials failed to pass acceptance tests."

J. B. Stevens, Mgr. Valve Sales & Engineering Schutte & Koerting

Four-way valves with DU bearings were used in an entirely new approach to a boiler feedwater heating system developed by the Kuljian Corp., applied by Cochrane Corp., and now installed in prototype unit at the Borough of Lansdale (Pa.) Municipal Power Plant. Du bearings contributed to reported appreciable savings per kw installed capacity by elimination of feedwater contamination, reduction of bypass leakage and resistance to the 400°F operating temperatures.

DU metal is an ideal bearing material for many applications. It withstands much higher velocities, runs much cooler at lower speeds than other unlubricated bearings . . . has a compressive strength of 51,000 p.s.i. DU metal is applied without the need for temperature-limiting adhesives . . . will withstand from -328°F to +536°F.

GARLOCK

Apply DU dry bearings to appliances, automobiles, aircraft, farm and industrial machinery, office equipment. Standard bushings and thrust washers available for ½" to 2" shafts; strip available for special fabrication. Write for engineering catalog DU-458. Special Products Dept., United States Gasket Company, Plastics Division

of Garlock Inc., Camden 1, New Jersey. *Trademark, Glacier Metal Company Ltd.



LITERATURE on drives and components

To get free copies of the following literature. use the Reader Service Cards bound into this issue.

SPHERICAL ROLLER BEARINGS

. . . and roller bearing pillow blocks are the subject of a 50-page booklet. Covers most aspects of design, materials, and applications. Different sections include bearing load analysis and lubrication methods as well as rating tables and selection data. Book 2760. Link-Belt Co., Indianapolis,

Circle No. 301 on Reader Service Card

TORQUE ACTUATORS . . . 20page Catalog 26282 starts off with what an actuator is and works up to dimension tables and torque ratings for single and double vane models. The catalog is well illustrated with typical applications and cut-away sketches. Ex-Cell-O Corp., Greenville,

Circle No. 302 on Reader Service Card

GEAR SHAVER . . . for camshaft gears uses diagonal shaving for faster work and greater latitude in handling shoulder gears with critical clearance between gear and shoulder. Catalog sheet describes and illustrates various machines and discusses design details. National Broach & Machine Co., Detroit, Mich.

Circle No. 303 on Reader Service Card

FLEXIBLE SHAFTS . . . come in seven standard sizes, 1/4 in. through 11/4 in., with plain or ball bearings and high-quality music wire core. Bulletin 250 has 10 pages of illustrated information, specifications, and a selection chart for the right-sized shaft according to speed and hp requirements. B. W. Elliott Mfg. Co., Inc., Binghamton, N. Y.

Circle No. 304 on Reader Service Card

DISC CLUTCHES . . . for stub or through shafts are available in various types with integral V-belt pulley, integral sprocket, cut off coupling, or extended sleeve. Four-page Bulletin K4 includes tabulated specifications and price lists. Edgemont Machine Co., Dayton, Ohio.

Circle No. 305 on Reader Service Card

V-BELT CATALOG . . . has 52 pages and covers a complete line of V-belts, including Cog-Belt, Poly-V and fractional hp types. Also contains section on industrial hose. Dayton Industrial Products Co., Melrose Park. Ill.

Circle No. 306 on Reader Service Card

WORM GEAR DRIVES . . . in a wide variety of sizes and ratios, with or without fan-cooling, are described and illustrated in Engineering Catalog HGB. Simplified selection and rating tables offer a quick and easy choice of the drive which meets specific needs. Foote Bros. Gear & Machine Co., Chicago, Ill.

Circle No. 307 on Reader Service Card

Engineers Operating Men Purchasing Agents . .

Save with **DAYTON ROGERS**

STOCK STAMPED SPROCKETS

76 Sizes-**Immediate Delivery**



IF you design, select or apply power transmission products for O.E.M. or in-plant use, consider these die-cut roller chain sprockets: they are priced far below comparable sprockets machined the conventions of the conventio

- For A.S.A. No's. 35, 40 & 41 chains
 From many materials
- Stamping principles and stock tools permit many modifications
- Special sizes tooled and run at surprisingly low cost. Test these sprockets in your applications. Write for specifications and prices.

ALSO: Photo-Mechanical Duplicating without the use of dies or stamping equipment. Write for details.

DAYTON ROGERS Manufacturing Company

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WHAT'S A THOUSANDTH OF AN INCH... MORE OR LESS?



With couplings operating at high peripheral speeds, it can mean the difference between early failure and long trouble-free life.

That's why all Waldron high speed coupling forgings (of SAE 4140) are first machined to +.001", -.000", and then hand fitted (sleeves first, then hubs). Bolts and nuts are weigh balanced, and the assembled coupling dynamically balanced as a unit-then match marked for reassembly.

Waldron high speed couplings are now operating at speeds of 70,000 rpm and more, and in drives up to 48,000 HP.

Even if your requirements don't involve such demanding service, it's good to know you have an extra margin of safety and reliability when you specify Waldron High Speed or any Waldron Coupling.



WALDRON-HARTIG DIVISION Midland-Ross Corporation
P. O. Box 791 • New Brunswick, New Jerse Circle No. 43 on Reader Service Card

ELECTRONIC DRIVES... feature a dc motor powered from an electronic control panel which rectifies ac line voltage. Provides accurate speed regulation to within 3% from no-load to full load over an adjustable 8:1 speed range. Bulletin 101. Louis Allis Co., Milwaukee, Wis.

Circle No. 308 on Reader Service Card

MOTORIZED PULLEY CATALOG

. . . gives specifications and dimensions for the latest models from 1 to 75 hp, with face widths from 22 to 57 in. A feature is a section of four charts to determine the proper pulley for the job. Lists accessories and possible modifications. Western Conveyor Co., Boise, Idaho.

Circle No. 309 on Reader Service Card

MINIATURE DC MOTORS . . .

Bulletin 121 details a new line of permanent magnet motors that measure 7/16 in. thick by 7/8 in. by 1 7/8 in. and develop 0.1 oz.-in. of continuous-duty torque. Globe Industries, Inc., Dayton, Ohio.

Circle No. 310 on Reader Service Card

DUCTILE-IRON PULLEYS . . . of split-cone taper design increased allowable speed 50% in a paper plant. Bulletin 17103 tells how. T. B. Wood's Sons Co., Chambersburg, Pa.

Circle No. 311 on Reader Service Card

OPEN CHAIN LUBRICANT... is said to make chains last up to three times longer. It combines features of a lubricant and a rust preventative. Four-page folder illustrates types of conveyors, transmissions, and elevating chains to show critical points for lubrication. Whitmore Mfg. Co., Cleveland, Ohio.

Circle No. 312 on Reader Service Card

GEARHEAD SERVOMOTORS ...

weigh 6 oz. and are offered in over 1000 ratios from 5:1 to 78125:1. Data sheet gives electrical and mechanical specifications, performance curves, and a circuit diagram. Lists available stock ratios. Guidance Controls Corp., Hicksville, N. Y.

Circle No. 313 on Reader Service Card





When you need a relube type bearing unit, you can get more compact design and lighter weight by specifying Browning. Reason: these new pillow blocks, flange blocks and take-up units have housings of unbreakable malleable, which is stronger and virtually indestructible even under the most punishing loads. The new relube type units feature self-aligning ball bearings secured to the shaft by two set screws in the wide inner ring. All have elongated bolt slots for wide adjustment and maximum interchange. Available in 29 shaft sizes from 1/2 to 21/6". New catalog BU-103 containing complete details is available on request from your Browning distributor. Or write to Browning Manufacturing Company Maysville, Kentucky.



FOR PROMPT DEPENDABLE SERVICE CONSULT YOUR BROWNING DISTRIBUTOR

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How to cut a keyway in 1 minute with a Minute Man keyway broach kit



MINUTE MAN KEYWAY BROACH KITS come complete with broaches, bushings and keystock. For keyways from $\gamma_{\rm ls}$ " to 1" in any bore from $\gamma_{\rm ls}$ " to 3".



- Select the right size bushing for the bore (sizes are plainly marked).
- 2. Insert the right size broach in the bushing slot.
- 3. Place under an arbor press and press through.





SAVE TIME WITH STANDARD STOCK SQUARE BROACHES

The comments of the comments o

Starting with a round pilot you can finish an accurate square hole in one pass in less than one minute. For ½" to ¾" holes. Hexagon and round broaches also available.

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Circle No. 36 on Reader Service Card

LITERATURE continued

FLUID DRIVES . . . in the Class 4 line are described in 20-page Bulletin A-719. Discusses principles and applications, illustrates components, and includes selection charts for both variable and constant torque jobs. Gives itemized list of data needed when ordering. American-Standard Industrial Div., Detroit, Mich.

Circle No. 314 on Reader Service Card

MOLDED V-BELTS . . . for light duty drives are described in Bulletin M220. Includes specifications for standard and non-standard belt sizes, and a drive selection table to determine belt size for electric motors. Raybestos-Manhattan, Inc., Passaic, N. J.

Circle No. 315 on Reader Service Card

INDUCTION MOTORS . . . singleand three-phase, from ¾ to 150 hp, are covered in 14-page Bulletin GEC-1049. Tables give dimensions, prices, performance data, ordering instructions, and accessories. Typical ratings and construction features are shown. General Electric Co., Schenectady, N. Y.

Circle No. 316 on Reader Service Card

INSTRUMENT BULLETIN . . . describes instrument drives, flexible shafts, geared adapters, gear boxes, tachometers, actuators, clutches, and flexible shaft and clutch assemblies. *Actuator Products Corp.*, Woburn, Mass.

Circle No. 317 on Reader Service Card

REVERSIBLE TURBINE . . . is designed for 1 to 45 hp with 1000 psi maximum inlet pressure. Steam, freon, or other gases can be used. Bulletin 2000 gives details. Dean Hill Corp., Indianapolis, Ind.

Circle No. 318 on Reader Service Card

MULTIRATIO REDUCER... offers over 70 ratios and quick changes through precision pick-off change gears. Construction features and mechanical specifications are described in a 4-page brochure. *Great Eastern Mfg., Inc.*, Springfield, Vt.

Circle No. 319 on Reader Service Card

CONTROL SYSTEMS . . . six-page Bulletin EE-1008 describes electromechanical systems and components for control of a wide variety of production machinery. Systems are equally suitable to conversion of existing equipment. Seneca Falls Machine Co., Electronics Div., Seneca Falls, N. Y.

Circle No. 320 on Reader Service Card

THIN-SECTIONED BEARINGS ...

are shown in position in equipment varying from wire-twisting machines to submarine periscopes. Bulletin S-112R contains 23 full-page drawings illustrating how the bearings save weight, space, and cost in many applications. Includes specifications and prices for a new line of radial ball bearings. Kaydon Engineering Corp., Muskegon, Mich.

Circle No. 321 on Reader Service Card

COMPONENTS CATALOG . .

has 416 pages of technical details, MIL specifications, and complete drawings of more than 12,000 stock items, such as precision gears, shafts, speed reducers, magnetic clutches, differentials, instrument plates, tool parts, and other associated components. *PIC Design Corp.*, East Rockaway, N. Y.

Circle No. 322 on Reader Service Card

IRON PULLEYS . . . in diameters and face widths to meet any commercial needs are specified in 8-page Catalog 101. Prices and dimensions for cast iron sheaves and matching V-belts are tabulated in List V-901-R. Both products can be made to customer requirements. Pyott Foundry & Machine Co., Aurora, Ill.

Circle No. 323 on Reader Service Card

ELECTRIC CLUTCHES, BRAKES

... the complete line is covered in a 6-page brochure. Provides technical data and diagrams of over 20 types of fixed field, miniature, and larger electric clutches and brakes for a wide variety of applications. A chart shows the reaction times for various static and pickup torque relations. Simplatrol Products Corp., Worcester, Mass.

Circle No. 324 on Reader Service Card

POWER TRANSMISSION DESIGN

FARM MACHINERY BEARINGS

. . . Catalog FM100 is divided for easy reference into categories of bearings, belt and chain idlers, cam followers, PTO bearings, wire guides, etc., and lists standard radial bearings adapted to farm machinery application. Nice Ball Bearing Co., Philadelphia, Pa.

Circle No. 325 on Reader Service Card

TENSION AND TORQUE CONTROLS... for webs and filaments are illustrated in a 6-page folder. Both clutch and brake units and edgeguide controls are described. Web Controls Corp., West Englewood, N. J.

Circle No. 326 on Reader Service Card

ADJUSTABLE SPEED DRIVES ...

Series 35 are dc motor drives using adjustable autotransformers in combination with full-wave rectifiers, giving infinitely variable speed adjustments over a wide range. Bulletin SL-351-460 has 8 pages of information, load tables, and suggested system variations. Cleveland Machine Controls, Inc., Cleveland, Ohio.

Circle No. 327 on Render Service Card

INDUSTRIAL LUBRICANT . . . application of Elco SCL lubricants in four steel plants are illustrated in a 12-page report. Also gives details of SCL concentrate which increases the film strength of ordinary mineral oils. Elco Lubricant Corp., Cleveland, Obio.

Circle No. 328 on Reader Service Card

VARIABLE PITCH SHEAVES . . .

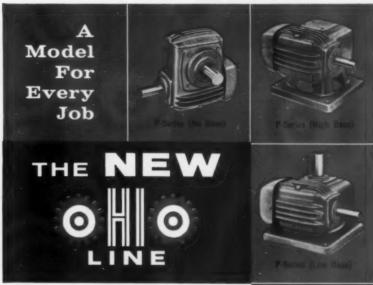
are spring loaded or manually controlled and can be adapted to nearly any machine using a single V-belt. Catalog SL-101-A contains specifications and stock drive combination tables for convenient selection. Browning Mfg. Co., Maysville, Ky.

Circle No. 329 on Reader Service Card

PERMANENT MAGNET MOTORS

... Bulletin 112 has performance and specification data on a new line of $1\frac{1}{2}$ in. diameter permanent magnet motors rated at 1/45 to 1/30 hp. Globe Industries, Inc., Dayton, Ohio.

Circle No. 330 on Reader Service Card



A Complete Line Of Fin And Fan Cooled Speed Reducers









80% MORE CAPACITY

Hi-Line reducers let you handle bigger loads — at far less cost than conventional reducers.

25% LESS SPACE

Hi-Line reducers are smaller let you save space without sacrificing capacity or service life.

...WITH A MODEL FOR EVERY JOB

Only a representative group of the more than 100 Hi-Line models are shown here. There are six series with centerdistances from 1.33" to 5.25" with input capacities from 1/16th to 18 h.p. They can be provided with or without fan cooling and most models are available with "C" flange motor mounts.

IMMEDIATE SHIPMENT FROM LOCAL STOCK

Write for the free Hi-Line Catalog — 65 pages of engineering and dimensional data.



Ohio Gear Distributors stock a complete line of gears and speed reducers



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These cards are your tickets to this prompt service. Use them to secure details about any item in this issue that has a key number. For instance:

ADVERTISEMENTS — a showcase of the latest in components, equipment & techniques.

NEW PRODUCTS — brief descriptions of significant new products and materials.

PRODUCT APPLICATIONS brief reports on successful applications of recently developed products and materials.

NEW LITERATURE — offerings of new catalogs, data books, price lists, and other valuable reference material.



Cedarapids Super Commander Portable Crushing and Screening Plant, built by Iowa Manufactur-Company, Cedar Rapids, Iowa, produces up to 500 tons per hour of crushed and screened material in four different product



This high capacity V-Belt Drive handles 60% more power in 30% less space!

Higher Capacity of Gates Super HC V-Belt Drives solves complex product-development problem!

In developing a larger crusher, requiring more horsepower, Iowa Manufacturing Company was faced with the problem of transmitting 400 hp from a higher-speed engine in a space that had been just enough for conventional V-belts carrying 250 hp.

At the higher speeds, centrifugal force made it impossible to go to larger sheave diameters to accommodate larger belt sections. A wider span of belts was ruled out by Highway Department requirements, which restricted overall machine width to eight feet.

Iowa Manufacturing's designers solved their primary problem of transmitting 60% more horsepower with new Gates Super HC V-Belts.

Because Super HC V-Belts have smaller cross section, use narrower and lighter-weight sheaves, pack higher hp capacity in a smaller 'package' than conventional V-belts, designers also succeeded in reducing drive weight, width and height - a decided bonus in equipment that must be moved frequently both on and off the highway.

Nation-Wide Engineering Service

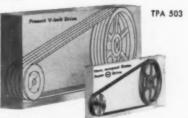
Your nearby Gates Representative can show you how to reduce drive weight, space and cost with Super HC V-Belt Drives. With Super HC, sheave diameters can be reduced 30% to 50%, drive space up to 50%, and drive weight 20% or even more.

Ask your Gates Representative for your free copy of "The Modern Way to Design Multiple V-Belt Drives," or write to The Gates Rubber Company Sales Division, Inc., Denver, Colorado.

The Gates Rubber Company, Denver, Colorado Gates Rubber of Canada Ltd., Brantford, Ontario



World's Largest Maker of V-Belts



Gates Super (HC) V-Belt Drives same hp capacity in smaller "package"



What is this writer trying to say? "In instances of mobile applications where fluid temperature due to intermittent operation and continued exposure remains low, a high-viscosity-index, low-pour-point fluid would be mandatory for reliable operation."

What he wants you to know is this: "Machines used outdoors in winter need oil that isn't affected by the cold." Well if that's what he meant, why didn't he say so? Good question. The reason you have to hack your way through doubletalk in some technical and business magazines is that writing things clearly and simply is hard work—a lot harder and much more expensive than putting them down in technicalese (the special language of engineers and longhairs.) The odd part of this problem is that even the longhairs who write technicalese don't like to read it. That is why the articles in this magazine have been distilled.

Distilled Writing gives you facts without fluff

Our research department told us that we—like other publishers—were taking too much of our space and your time to get the facts across. That's where Distilled Writing comes in.

WHAT'S DISTILLED WRITING? It's copy with the extra words squeezed out. It gives each article exactly as much space as it really needs . . . not one line more! This isn't a digesting process: all the facts are still there, but the verbiage is gone. For example, we take this kind of writing . . . and distill it to this:

eliminate unwanted vegetation

kill weeds

It is used to rupture missile frames in flight to initiate aerodynamic distintegration.

It makes missile frames explode in flight.

formation of iron oxide binding the two surfaces

rusted together



Distilled Writing is the registered service mark of The Industrial Publishing Corporation

- HOW WE DEVELOPED DISTILLED WRITING. First we hired Dr. David Kinsler to head up our distilling on a fulltime basis. He works with all our editorial staffs, teaching sharp, concise writing. Second, we retained Rubert Gunning, the top authority on readable writing, as our consultant. Third, we put every line of copy—whether staff-written or by an expert in the field—through the distilling process before it goes to the printer. Our whole editorial effort is aimed at telling the story brightly, clearly, briefly.
- **WHAT DOES THIS MEAN TO YOU?** The story that used to take four pages is now told in two or three. Shorter articles mean more of them in each issue. You get more information for your reading time and you don't have to dig it out. It takes more work for us to do it, but Distilled Writing pays off in the time it saves for our busy readers.

